AUG 10 1923

# DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

EDITED BY EDWARD LIVEING, B.A.

SCIENTIFIC ADVISER: A. S. RUSSELL, D.Sc.

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A VIEW IN VERGIL'S COUNTRY
Roadside stream, south of Carpendolo

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JOHN MURRAY, 50A ALBEMARLE STREET, LONDON, W.1.

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# Editorial Notes

THE idea of a "lost Atlantis" has for several centuries fascinated mankind and attracted its more imaginative members to weave fantastic legends about some once beautiful continent inhabited by a highly civilised people before it sank into the waves of the Pacific thousands of years ago. In the July number of DISCOVERY we published an account of a new theory about the structure of the earth.[1] The theory is that of a German geologist, Kober, and in one sense is a development of Professor Wegener's new theory of land and continent formation. Kober puts forward the idea that in the process of cooling the earth's crust has come to consist of large, solid blocks of matter moving gradually through a softer layer. The large blocks meet each other, the softer layer being pushed up in between them during the gradual process of contact. In this way mountain masses and high land are thrust up above the sea level, only to subside again millions of years later as the blocks beneath corrode owing to their pressure against each other. Such is the theory in bald outline. Though it must be accepted with considerable reserve and is certain to provoke much criticism, it gives a plausible explanation of some quite recent earth disturbances—of the strange fate, for instance, that appears to be overtaking Kamchatka and of the earthquakes last November along the coast of Chile.

* * * * *

The disintegration of Kamchatka, that vast north-eastern peninsula of Asia, 780 miles long and at its widest part 280 miles broad, appears to be taking place at enormous speed. An article in the *Daily News* in June of this year mentioned that "from the beginning of February till April 16, no fewer than 195 shocks were recorded, gradually increasing in intensity until houses collapsed and huge floes of ice from the ocean were thrown far inland. On April 18 a particularly violent shock occurred, accompanied by a tidal wave. . . . The most extraordinary feature recorded is that the water of the Kamchatka River has vanished into the bowels of the earth."

* * * * *

Kamchatka, according to Kober, is part of a geologically new, and therefore unstable, orogene zone; the west coast of South America, including Chile, has been similarly classified by him. This brings us to the borders of our "lost Atlantis." Whatever caused the disappearance of this huge land mass, and whether we accept Kober's theory of subsidence owing to corrosion as a reasonable explanation, certain it is that Atlantis did once exist. We have not only geological, but also botanical and zoological, evidence in support of its existence. It was more than an island, and it stretched from Brazil to Australia, even including a vast portion, if not the whole of, Africa in its extent. Geologists call it Gondwana Land and calculate that it existed some 20,000,000 years ago! It is natural that that portion of this ancient continent which lies beneath the southern waters of the Pacific should attract the greatest interest, for in the scattered archipelagoes of Polynesia we still have the remains, the mountain peaks, as it were, of the "lost Atlantis."

* * * * *

Thorough investigations of the Pacific will take place in the near future, and three scientific expeditions have already been organised with these purposes in view. The Natural History Department of the

[1] See p. 171, *The Structure of the Earth*, by O. H. T. Rishbeth, M.A.

British Museum despatched an expedition, under the leadership of Captain George H. Wilkins, a member of the recent *Quest* Expedition, to Australia last February. This expedition will make as exhaustive a collection as possible of the mammals and flowers of the island continent. Such a collection is certain to throw a great deal of new light on the past land-bridges between Australia and the larger continents of to-day.

* * * * *

The effects of the Chilian earthquake on the ocean bed of the Pacific off the American continent are to be investigated by an expedition under the auspices of the Carnegie Institution of Washington, and warships of the United States Government will be employed. The area to be covered lies off the Pacific Coast of America, between San Francisco and the Mexican boundary, and soundings will be made over some 10,000 square miles of ocean.

* * * * *

Last January a very interesting new society was formed at Burlington House by a meeting of men of science—the Scientific Research Association. No doubt we shall be in the position of bringing the activities of this association before our readers from time to time, but for the moment we may mention that one of its first decisions was to organise an expedition to start this summer for the South Pacific, where scientific research of various kinds is to be carried out, and the effects of the Chilian earthquake in this direction are to be examined.

* * * * *

The likelihood of any further discoveries of land in the South Pacific and the Southern Ocean is very small; the voyage of the *Quest*, admittedly hampered by engine trouble and ill-luck, resulted in no "finds" of mythical lost islands. The world which we inhabit is becoming commonplace; we cannot, like our forefathers of several centuries ago, look forward to the excitement of some expedition revealing new lands and new peoples in unknown quarters of the globe. From the early days of Greek civilisation and onwards to Elizabethan times, there was always the possibility present in men's minds, not merely of discovering new lands, but of discovering in those lands communities enjoying a life of greater freedom and happiness than that to which they were accustomed themselves. Nothing could have been more natural than that imaginative men in the past, standing on the shores of their respective countries, looking out across great wastes of water, and feeling tired of the circumstances of life which they and their fellows had to endure, should have conceived of distant Utopias beyond the rim of the horizon—the Hesperides, the Isle of Avalon, the Blessed Land of the Dead, the Elysian Fields, the Fortunate Isles. Even Francis Bacon, who never let his ideals endanger his safety and comfort, wrote of a *New Atlantis* where science and the arts had been brought to a high degree of efficiency.

* * * * *

For imaginative power, breadth of outlook, and bravery of vision, the *New Atlantis* does not bear comparison with More's *Utopia* written a century earlier. This wonderful book, of which a new translation has just been published,[1] constitutes a landmark in the progress of idealism even greater than St. Augustine's *De Civitate Dei* and Plato's *Republic*, to which it owes much of its inspiration. It paints the picture of a country inhabited by a true commonwealth in which there is no private property and "though no man has anything, yet all are rich," in which science and philosophy have come into their own, where war is regarded "with utter loathing," and where selfish aims and ambitions obtain no reward.

* * * * *

In the clash between Capitalism and Labour to-day we are naturally apt to think too much of present "wrongs" and immediate "dangers." The ideal of a state in which health, happiness, beauty, and progress of knowledge shall be ensured is sacrificed to political ideals which should be subservient to it. More important than the destruction of systems of government is the destruction of disease, slum areas, outworn traditions, ignorance. Science in all its branches is working towards establishing a Utopia on this earth. Last year will remain memorable as the year in which man found out how to allay, if not entirely to cure, the disease of diabetes; this year he has discovered a vaccine which may sooner or later rid the world of consumption; this year, too, sees the start of the most determined onset on cancer that has ever been attempted. The sciences of anthropology and psychology are giving us a knowledge of the workings of the individual mind and of the behaviour of "groups" of individuals, which is being felt directly or indirectly in social life and traditions all over the civilised world.

* * * * *

A brilliant forecast of what our world may be like several thousand years hence is given in Mr. H. G. Wells's *Men Like Gods*.[2] Though his Utopia is placed

[1] *More's Utopia*. Translated into modern English by G. C. Richards. (Oxford: Basil Blackwell, 3*s*. 6*d*.) Earlier translations from the original Latin have been characterised by a dullness of language, which has rendered them almost unreadable. This new translation by a Fellow of Oriel College, Oxford, is admirably lucid, though it adopts to a certain extent the written English of More's own period.

[2] Cassell & Co., 1922.

in another planet, the allegory is obvious. The planet into which the "Earthlings" are caught up by the exploit of two Utopian scientists is one in which the "Age of Confusion" has been left behind several thousands of years ago. In this planet long-distance travelling is done in silent flying machines; speech and conversation are carried on by means of transmitting thought from mind to mind, languaged difficulties being thus avoided; labour-saving methods have reduced heavy and laborious work to its minimum; war and disease, injustice and fear, have been completely banished; the inhabitants have set their minds and bodies free to probe into the universe outside their own world. Into the narrative and details of this book we cannot go; the "Earthlings" introduce disease and war into it, but both are combated successfully and, like Adam and Eve, the "Earthlings" are sent back from this paradise to their own planet. Many an "earthling" will throw mud at Mr. Wells's Utopia, and scientists may not agree that all its exploits in chemistry, physics, and engineering will ever be feasible. But it is a great book all the same, for it contains a striking analysis of our present Age of Confusion, and its forecast of the future is a triumph of the human intellect. We believe that we are struggling slowly and painfully out of an Age of Confusion, and that science, in the widest meaning of the word, is already in the vanguard. Atlantis may never emerge before the eyes of adventurers in the Pacific; we are all adventurers, and Atlantis is gradually—very gradually—rising in our midst.

# News of the Month

### TWO NEW VOLCANIC ISLANDS

Of the many instances of earth disturbances this year one of the most extraordinary is the recent formation of two small volcanic islands in the China Sea. *The Geographical Journal* for July publishes reports on these remarkable phenomena. The first report was written by Captain Horikawa of the *Wakasa-Maru*. During the voyage of this vessel between Hong-Kong and Singapore the peak of Pulo Cecir de Mer "bearing 298 degrees at a distance of 7¼ miles" was passed at 3.20 p.m. on March 2. A long range of white smoke was noticed (ascending from the sea) by the second officer. The captain altered his course in the direction of the smoke, thinking that it was a tank-ship on fire; but on ascertaining that the phenomenon was due to volcanic action, he put his ship back on her original course at 5.45 p.m. and passed the smoke at about 3¾ miles off. "The sea surface in the neighbourhood of the volcanic action was much disturbed, but could not be well seen. A cloud of grey vapour rose to some height, and made a long range of clouds in the blue sky extending to the horizon to leeward. At intervals a large mass of gas appeared above the disturbed surface of the sea. Sea-water with ashes fell from it on its first appearance, and it then ascended with great speed, growing larger as it rose and balloon-shape, becoming eventually like a large mass of cumulus cloud and following the range of clouds which had been blown to leeward. The height was estimated at 7,000 feet."

As a result of Captain Horikawa's report, H.M.S. *Carlisle* made a passing examination of the sea in the region of the disturbance during her voyage from Singapore to Mirs Bay. This took place on March 8, that is, six days later than the first sighting of the phenomenon; and Captain Dickens, R.N., after sighting the column of vapour, closed in nearer and discovered that an island of a horseshoe shape, rising at the W.S.W. end to a height of about 80–100 feet, had been formed.

Since Captain Dickens's report an Admiralty Notice, based on a report from H.M. Surveying Ship *Iroquois*, dated May 13, has been issued. On this date the volcano was still active and the island had grown to a height of 97 feet. Moreover, a second volcanic island had been formed 2 miles south of the first; this was still in eruption and about 1 foot in height. A shoal-bank, 12 fathoms under water, was also discovered a mile south-east of the first island.

One of the most interesting points about these volcanic activities, as *The Geographical Journal* observes, is that they are "a long way removed from any recent volcanoes." The whole phenomenon raises many questions, such as, "Will these islands subside into the sea again or, just as likely, will they cool down and will it be possible to land on them?"

That the surface of the earth is in a more disturbed condition than it has been for a great number of years there is no doubt. The disturbances off the coast of Chile last year, and the strange phenomena in Kamchatka, widespread earthquakes in China, and the eruption of Etna, all in the first six months of this year, must surely in some way be related to one another.

### THE CINEMA IN THE UNITED STATES

The enormous growth of the cinema industry in the United States is amply illustrated by statistics recently issued by the Motion Picture Directory of New York. They reveal the fact that there are approximately 18,000 moving-picture theatres in the whole country, providing a total seating accommodation of from 8 to 10 millions. It is estimated that at least 50,000,000 Americans attend the cinema each week, and that sometimes attendances rise to 15,000,000 a day.

We believe that the day is not far distant when the Cinema and Wireless Broadcasting will usurp the present position of the daily press in supplying the public with its news. Experiments are also on foot for reproducing films by wireless. We can only hope that both industries will realise their enormous power over the minds and emotions of humanity and attempt to follow more conscientious principles and interpret news with less bias than many of the present newspapers existing in this world.

# The Transmutation of the Elements

By A. S. Russell, M.A., D.Sc.

*Student of Christ Church, Oxford*

ALCHEMISTS are still alive. My quarrel with them is that they are mostly men of one idea, the idea being a wrong one. For some years I have taken an interest in their exploits, and recently, when I analysed the various stories that have come to me, I was struck with their great similarity. It is as though the same alchemist bobbed up from time to time at different places with the same story, but actually this is not so; it is the same idea that in different places and at different times during the last twenty years has inspired different men. To make gold out of lead is merely one of those conventional methods of raising the wind which include the confidence trick, the Spanish prisoner story, and the poisoning of insured relatives with white oxide of arsenic. I do not say that our conventional alchemist is necessarily insincere or even wilfully tells untruths. Occasionally he is quite sincere, or, as it has been described to me, "candour and innocence are reflected from every pore of his body." He is merely under a delusion, and he wishes to share this delusion with his fellows, particularly if they be journalists or economists, best of all if they be company promoters or politicians. It is hardly fair to ask him to discuss the matter with a scientist. It disturbs him. He is apt to get rattled. Often his apparatus for doing the job breaks down just before the scientist arrives. It is curious that a scientist should have such a unique effect.

## Two Gold-makers

It is unfair to alchemists to talk of them in this way without saying, on the other side, that on two occasions they have demonstrated their system before the eyes of a scientist. On the first occasion the alchemist made mercury from lead, and after resting from this truly Herculean feat, made gold from mercury. The lead and the furnace to melt it were provided for him, the mercury, it was discovered, came from a hip-pocket, the gold from a sleeve. On the second occasion, which took place after the death of the first alchemist, a mixture of gold and lead was actually prepared from carefully purified lead under strict conditions to avoid the results of prestidigitation. (The alchemist was clad in a bathing-suit.) But even he insisted on stirring the molten lead with a steel rod, and afterwards the rod was found to be hollow. The ingenious man had had it filled with gold dust and closed with wax, so that the gold passed into the lead without difficulty soon after stirring had begun.

If one could make gold genuinely out of lead or anything else, there would be no occasion to adopt the tactics of the alchemist—in trying to float a company or to sell the patent to a government, etc.—the gold-maker has merely to continue making the gold, and soon he will acquire all the wealth as well as all the scientific fame he can desire. He needs no one to help him. But actually, unless present-day science has gone right off the track, no one can make gold in bulk or even in quantities that can be seen or weighed. Yet science does not declare that transmutation is impossible; quite the contrary. But in showing that transmutation is not only possible, but actually going on in nature, it reveals how absurd, or at the best how distorted, are the usual ideas and claims of alchemy.

The disintegration or transformation of atoms that is known as transmutation is most conveniently described under two heads: (1) transmutation which occurs spontaneously in nature and which is confined to the very heaviest elements, and is so far uncontrollable by man; and (2) artificial and controllable disintegration, due to the experimental skill of Sir Ernest Rutherford, of Cambridge, which is confined at the time of writing to a few of the lightest elements.

## Spontaneous Transmutation

I pass now to the first part of the work, dealing with genuine atomic disintegration, i.e. to radio-activity First of all, what is meant by disintegration? Let me say a few words about the atom in reply. An atom is supposed to be a structure about $10^{-8}$ cm. (about a hundredth of the millionth part of an inch) in diameter, having at its centre a tiny thing called the nucleus. The nucleus consists of both positive and negative electricity (with, however, a great deal more of the first than of the second, so that it is positive); it is only about $10^{-13}$ cm. in diameter (the hundred-thousandth part of the diameter of the atom), and yet it contains practically the whole of the mass of the atom. Round this nucleus are spaced many single charges of negative electricity called electrons. The heaviest atom that is known, the atom of uranium, has ninety-two electrons; the lightest, that of hydrogen, has but one. It is the nucleus, not its surrounding electrons, which is the seat of atomic disintegration. Alter the nucleus, if you can—it is extremely difficult to do so, but not impossible—and you have brought about transmutation. Now, this tiny nucleus has a structure about which something is known. It appears to consist of an assemblage of the nuclei of

helium and hydrogen atoms, and of certain electrons. The number of helium nuclei may be small or great according as the atom is light or heavy, but the number of hydrogen nuclei is supposed to vary only from 0 to 3. But we need not discuss these speculations further. The essential point is that the nucleus of a radio-element may expel part of itself in two ways: (1) it may expel the nucleus of a helium atom—thereby emitting energy (for the helium nucleus weighs 4 and travels at about 10,000 miles per second) and thereby also becoming transformed or, if you like, transmuted, into the nucleus of an entirely different element; or (2) it may shoot out an electron, which has, however, much less energy than a helium nucleus (because it has "almost no weight"), and after so doing become an entirely different nucleus. Now, it is found that whenever a helium-nucleus is emitted by a radio-element, the new element formed lies *two* places *lower* than the old in the ordinary way in which elements are arranged, and whenever an electron is shot out the new radio-element lies *one* place *higher*. This rule is found to hold perfectly in radio-active transformations, from the heaviest radio-elements down to the inactive element lead. There is no reason to think it would fail to hold, therefore, for any body which might be compelled to expel a helium nucleus or an electron. Let us now arrange the elements from platinum to lead in the order of their atomic weights. This order runs platinum, gold, mercury, thallium, and lead. If lead could be induced to expel a helium nucleus, the resultant atom would be mercury (two places lower); by a similar transformation platinum would arise from mercury. If, finally, an atom of platinum could be induced to expel from its nucleus an electron, gold (one place higher) would result.

But radio-activity teaches that the essential point about this kind of transmutation is the energy produced and not the body produced as a result. It is the energy alone that is obvious and important. The gold or other bodies produced would hardly have the importance even of by-products. A man looking for gold as the result of the transmutation of lead is more foolish than one who cannot see that the importance of an internal-combustion engine lies in making a motor-car go, because he is intent on studying the waste gases shot out by the exhaust. A gram of radium with its products gives out 130 units of heat-energy every hour *continuously*; yet radium is a very rare element, and its rate of transmutation is actually very slow. Imagine the energy of radium if we had pounds of it, and if its rate of transmutation could be speeded up at will. How much greater would be the energy evolved by common elements like lead or mercury, procurable by the ton, if they could be made to do by artifice what radium does spontaneously! But so far the heavy elements cannot artificially be made to disintegrate, but experiments with a few of the lighter ones show that the process, although extremely difficult, is to some degree possible, and these will now be described.

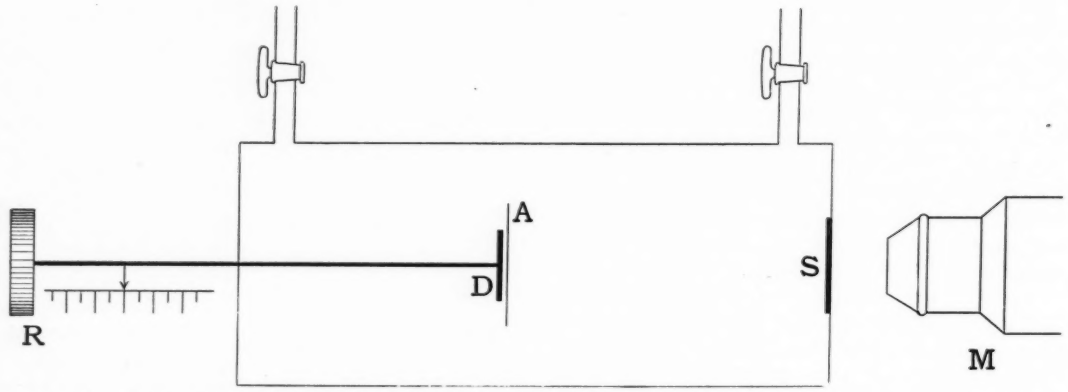
## Artificial Transmutation

These experiments have been done by Sir Ernest Rutherford at Manchester and at Cambridge, and the method in outline is this. The nuclei of different atoms are bombarded by swift α-particles (which are helium nuclei) from the radio-element radium C; a minute fraction of the nuclei of certain elements is found to be ruptured by these particles and a small portion of a nucleus is broken off; these broken-off pieces are examined by an ingenious device and found in all cases to be nuclei of hydrogen atoms.

The nucleus of an atom, it has been mentioned, is so small with respect to the atom itself that if the latter were magnified to the size of an ordinary market-town, the former would measure little more than a foot every way. It is obvious, therefore, that to smash up the nucleus—which alone insures artificial disintegration—not only is a projectile of some kind necessary, but particularly accurate shooting must be done. Since there is no means of taking aim or correcting fire, the only means of hitting the target is to fire a very large number of projectiles. A few then have a chance of hitting.

The α-particle from radium C is a helium nucleus with a mass of four units, shot out with a velocity of about 12,000 miles per second. This is, of course, a very tiny mass, but mass for mass it has about four hundred million times the energy of a rifle bullet. When it strikes a screen of crystallised zinc sulphide it emits a flash of light, a scintillation, which may be observed through a low-power microscope by eyes well rested in the dark. The light seen thereby is known to be due to the collision of a single nucleus with the molecules of the zinc sulphide screen. It is found, however, that, if the screen be moved away from the source of α-particles farther than 7 cm. in air, no light due to these particles can be observed. That is because 7 cm. of air offers such resistance to the passage of these nuclei that they lack sufficient energy to cause a flash of light. If next these nuclei are compelled to force themselves through a substance much denser than air, say a thin sheet of magnesium or of paper or of mica, they will naturally be stopped much sooner, but they will go a distance before they are completely stopped, which is roughly inversely proportional to the sheet's density. Rutherford did his first successful experiments with nitrogen, but a later experiment with aluminium is more convenient

to describe. The apparatus he used is shown in Fig. 1. He found that if a thin piece of magnesium foil, equivalent in stopping power to 7 cm. or more of air, were interposed between the source of α-particles and the zinc sulphide screen, on which they could be detected, the screen was quite dark. This is, of course, an old result, and what was to be expected. But the new result was this, that when aluminium foil was substituted for the magnesium many scintillations appeared on the screen, and further examination showed that the particles producing these scintillations were not α-particles, but particles that could travel as far as 90 cm. in air before they were completely stopped. They were proved to be hydrogen nuclei which must have been broken off from those aluminium nuclei which had had a head-on collision with the




In a glass tube which may be evacuated is inserted a disc *D* containing the body which expels α-particles. It can be brought nearer *S* by the screw *R*. *S* is the screen which emits light when struck by the particles from *D*. The flashes are observed by looking through the microscope *M* focused on it. *A* is a movable screen placed in front of *D* so as to be bombarded by the α-particles.

α-particles directed against them. The number of aluminium nuclei struck in this way is relatively extremely small. Rutherford has calculated that only about two α-particles in every million get near enough to the nucleus to be able to break off a piece of hydrogen, although each passes through about a hundred thousand atoms of aluminium before it is stopped; that is to say, there are only two really successful hits in a hundred thousand million shots.

## Elements which may be Transmuted

Of the elements experimented on in this way, six only have been artificially disintegrated. They are boron, nitrogen, fluorine, sodium, aluminium, and phosphorus. These bodies have atomic weights expressible by the formulæ $4n \times 3$ or $4n \times 2$ where $n$ is an integer and, since 4 is the atomic weight of helium, their nuclei may be regarded as made up of helium nuclei with 3 or 2 attendant hydrogen nuclei. It is probably the latter which are ejected when the α-particle strikes. The elements whose atomic weights are less than 32 but not expressible by the above formulæ, do not appear to be disintegrated by α-particles, and *all* elements with atomic weights greater than 32 are similarly inert. In the case of aluminium, which shows the phenomenon best of all, it has been shown that the energy of the liberated hydrogen is greater than that of the liberating α-particle; which means that some of the internal energy of the atom has been tapped. This liberation of internal energy occurs, as has been mentioned, spontaneously in radio-active bodies, but it is important to have direct proof of it from those elements artificially disintegrated.

Let me say this again in different words. Of the eighty-seven known chemical elements, six at present have been artificially disintegrated and four of these are very common elements. The disintegration or transmutation appears to be quite genuine. In all six cases the piece knocked out is the element hydrogen, and the piece that remains becomes a new element. In some cases there is energy "tapped" from the source of internal energy of the atom. But the only means of procuring this type of transmutation artificially is the high-speed α-particles emitted by radio-elements, and these are and always will be among the very rarest of substances. So that, although all these processes are of great interest to the theoretical scientist, there has been just enough done to encourage the exploiter of scientific knowledge, the man whom people describe so glibly as about to tap the hidden forces of the atom, if not to hope, at least not to despair.

## Conclusion

To sum up in a few sentences. The dream of the

alchemists and the popular ideas of to-day concerning the transmutation or artificial disintegration of elements are in many points wrong, but they are not altogether wrong. There is a germ of truth in it all, but it is truth distorted. Emphasis, for example, has been put on the gold, and not on the thing many times more important, the liberated energy. In radioactivity we see transmutation going on among the heaviest elements with liberation of relatively very large quantities of energy, but as these elements are among the rarest of all, the whole business is really on a very tiny scale only. Also it is spontaneous; it exists of itself; we cannot accelerate it. Some of the lightest elements, however, have yielded to the attacks upon them, and are in fact disintegrated at the will of the experimenter. But this process can be carried out, from the nature of things, to a very small extent only. It can be proved that the disintegration is real, and that the internal energy of some atoms may be tapped; but although a beginning has been made, it would at present appear unlikely that the process may be so extended as to do things on what is known as a commercial scale. The main thing, however, is that a real beginning has been made, and the rest may be very safely left to the future.

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# Vehicles and Routes of Thought

**By T. H. Pear, M.A., B.Sc.**

*Professor of Psychology in the University of Manchester*

THERE are unfortunates for whom Windermere is separated from Keswick by twenty miles of a first-class road and fifty minutes of other people's dust. For the lucky ones, there stretch between these towns a hundred miles, a week or more, and ways infinitely various, blessedly unclassable and consistently dustless. What his route may mean to an aviator who flashes over this region in ten minutes, I neither know nor care.

The relevance of this introduction lies in the fact that persons whose interest is merely to transport themselves from one spot to another seldom speculate overmuch about alternative vehicles or routes unless the former let them down or the latter become blocked. But a snowstorm, a strike, or a flood will instantaneously coerce their interest in both these subjects. Moreover, your rock-climber, walker, motorist, and aviator, in their conversations about a hilly district, are clearly, from the subjective or psychological point of view, discussing different and incommensurable things.

Now those peculiar processes of travel through reality which we call thinking are facilitated by vehicles of various kinds. Prominent among these are mental images, and not, of course, visual images alone. For the present purpose it will be assumed that every kind of sensation we have had is capable of leaving behind it the material potentiality of its revival in the form of an "image," visual, auditory, tactual, and the like. Words, which are schematic images heavily charged with meaning, are the chief carriers of some people's thought, and "conscious attitudes," or *Bewusstseinslagen*, the wraiths of gesture-language, the timid, incipient contractions of muscles which under the suns of Sicily or Los Angeles might thaw out into full-blooded gestures, are the natural bearers of others. In some people, a train of thought, if it lasts long enough, may command all these vehicles.

But just as travel has purposes of which carriages are mere instruments, so in people's minds meanings express themselves more or less successfully and completely through these images and bodily sensations. And there are psychologists who hold that in highly developed minds meaning may function in its own right, that "imageless thoughts" exist; that they are not "fancies that broke through language and escaped," but thoughts which, as yet untrammelled by language, living in a primitive nakedness, would be cramped by clothing, even if it were the lightest vestments of a poet's imagery. Other psychologists, while accepting the empirical data upon which this belief is founded, would urge that before embracing it we should explore exhaustively every aspect of the possibility that these gossamer meanings are carried by suitably delicate contractions of those muscle-groups subserving speech, gesture, and emotion.

But the last ten years have seen a fairly general mobilisation of psychologists for immediately practical uses. As a result, since psychologists are still, comparatively speaking, a small band, there has been a certain aversion to this inherently challenging problem of theory. We must now turn away, too, but for a reason more simple, obvious, and perhaps more convincing than those which have led to this deviation of interest.

## The Varying Manner in which Individuals Think

The main purpose of the present article is to express

a view which has already been elaborated elsewhere,[1] but to substantiate it further by evidence from other quarters. It is that imagery, so far from being the mere scaffolding of the thought-structure, eventually to be knocked away and destroyed, leaves a permanent impress, in myriads of ways, upon the thinking of its possessor. Perhaps the very elect may succeed in shaking off its limitations, though this is far from certain. What is certain is that many persons live for ever boxed up in their own image-world, seldom or never suspecting that their best friend lives in another. Just as painting, sculpture, writing, music, dancing and acting are inevitably limited by their media, it would be surprising if a man whose imagery was for the most part visual should look at life in the same way as one whose chief memory-material was auditory. That these two friends use the same words does not invalidate this statement, for nobody can expect them continually to express themselves in pictures and symphonies, or even in sketches and trills. But for both of them words are often but sorry makeshifts. They would probably agree that, whether or not speech was given us to conceal our thoughts, it usually distorts theirs.

But at this point a predominantly verbal thinker is sure to speak up for his class. For him at least, he will insist, words are seldom reach-me-down, standardised garments for meanings which gawkily project from them on all sides, but words clothe his meanings as silk yields to every fold of the body. For him, words often *make* meanings, as the annual ukase from Paris appears to mould feminine anatomy, or as fashions in shoes actually do. Much more is the man who thinks verbally likely to say in praise of the power of words and, unless he be exceptional, he is sure to assume that others are like himself. It may well be that he thinks *in* rather than *with* words: that often, when he thinks, words and very little else besides are in his mind; that he has a large and easily accessible stock of "ready-mades" in his mental wardrobe, or is, perhaps, less finicky in his choice of garment.

It must not be forgotten that persons also exist with predominant imagery from other sense-spheres; imagery of bodily movements other than those mediating speech, of touch, of taste and smell, and of organic sensation. Their mental worlds have just as much claim upon our respect as those of the visual and auditory thinkers,[2] though certainly they do not get it. But the rest of this paper must be given up to the description of some peculiarities of the predominantly visual thinker; the joys afforded him by his vehicles and his routes of thought, and the straits to which he is often reduced by them both.

The following lines are based upon many conversations with different persons in laboratories, in hospitals, and in ordinary life. They are intended to do no more than to record provisionally some abilities and disabilities of certain persons, and to inquire into the relation between these peculiarities and the different kinds of imagery which play a predominant part in their thinking. The investigation has not been deep or wide enough to warrant the attribution of these abilities and disabilities, occurring in a "strong" visualiser or verbaliser, exclusively to his particular type of thought-imagery. There seems, however, to be evidence, both internal, from the subject's introspection, and external, from the observation by others of his behaviour, that such peculiarities are very potent factors in the thought-apparatus.

It will be obvious to a reader who is familiar with recent developments of psycho-analysis that another method of classifying individuals, which maybe cuts across the distinction of image-type, demands notice. It is founded upon the directions in which the thinking, feeling, and acting of the subject are usually turned; whether towards the outer world or towards his own personality; it is the distinction, by which some psychologists divide human beings into two classes—the introvert and the extrovert.[3] But how far early differences in predominance of imagery may be the cause or the effect of the different ways in which these two types think, nobody knows at present.

With these provisos, then, I venture here to put on record the following tentative beliefs about certain persons in whom visual and verbal imagery respectively are predominant. They will be termed visualisers and verbalisers. In giving them these names, it is not implied that the visualiser cannot think in words nor that the verbaliser cannot think in pictures, and it is recognised that these descriptions may not prove to be true of all visualisers and verbalisers. But I mean that in both of them the vast majority of their thoughts use one rather than the other of these modes of development. A verbaliser may either mentally "see," "hear," or "speak" his words. But the type described in the following paragraphs usually employs, or is employed by, what is termed vocal-motor imagery, often blended with imagery of the sounds of the words.

## The Visualiser and the Verbaliser

When remembering, the visualiser attributes special importance to the appearances of persons and things; possibly even more than when they were actually present in experience. This sensitivity to the look

[1] *Remembering and Forgetting*, London, 1922, pp. 205–31.

[2] Cf. Helen Keller's account of her blind-deaf life in *The World I Live In*.

[3] Cf. C. G. Jung, *Psychological Types*.

of things seems to make him more susceptible to influence by the written (and especially the printed) words of others than by their spoken words. He is a bad listener, finding it difficult to comprehend a scheme when it is orally explained, and easy to grasp it from a printed explanation. He seldom remembers the actual words used in his own conversation or in that of other people, and wonders that others can do so. He seldom talks to himself, either loudly or quietly, and when things go wrong he probably gets a subnormal amount of satisfaction from the use of expletives, unless they be new and loaded with picturesque imagery.

Speech about any matter which requires directed thought is, on the whole, slower and more unsatisfactory for him than for the verbaliser. Writing may be for him a pleasure or a pain. If pressed for time, it is an uncongenial task to describe or to express in writing something about which he really cares, for he knows that the words will fall short of, or overlap, his real meaning. With plenty of time before him, it may be amusing and challenging to discover the words which will most neatly fit what he wants to say. To have to write in a hurry about a serious matter is like opening a bud before its time, and he will usually offer an inexhaustible series of perfectly cogent reasons why such writing shall not be attempted. This does not prevent him, of course, from using words or phrases as gestures of politeness, as one may do at the end of a letter. But I venture to suspect that the visualiser may be less easy to hypnotise than the verbaliser by the sonorous phrase in politics, or the ancient and respectable in science. (It may be well to except from this statement some verbalisers who have had a philosophical training.) Perhaps for the verbaliser the platitude is a little more impressive, a little less likely to be seen through, just as the platitude's pictorial homologues ; impressive tailoring, or an actress's pretty professional smile, may have similarly paralysing effects upon the visualiser's thinking.

To many an orator's rumbling stream of words, as round and as alike as beads, connected by an almost imperceptible but cheap string, he is specially impervious, unless they happen to evoke vivid pictures. Even then he may not welcome them, preferring to make his own, like many of his kind who object to actual pictures which profess to illustrate a novel. He often finds it difficult to keep pace with a speaker who employs abstract and general terms. This is sometimes because his simple arithmetical thinking is easily outstripped by the speaker's comprehensive algebraic processes. At other times, perhaps, he is hindered by the results of applying this apparently satisfactory algebra to concrete cases and finding that it is true only of imaginary quantities.

It may be, too, that a person of this type, when he falls sick or is otherwise in trouble, is less easily and completely comforted by the spoken word, uttered either by another or by himself, unless, for special reasons, often connected with visual factors, the word is extraordinarily impressive. This might explain some interesting observations. An intelligent patient, during the course of a severe nervous trouble, was greatly troubled by pseudo-hallucinations [1] of a distressing kind, which vanished after their sources had been traced by analysis. During an interview with the doctor, the patient complained that, although on leaving the consulting-room he invariably felt better for an hour or so, after that time the meaning of the conversation which had relieved him entirely vanished, and the time seemed to have been wasted. One day a colleague suggested that this might be connected with the patient's predominant visual imagery, and that therefore it might be worth while to try the effect of writing down for him the gist of the hour's conversation. This was done. The patient then reported that whenever one of these specific worries arose he would read the slip of paper which summarised the therapeutic conversation about it, and feel immensely relieved. One night the doctor had attempted to lessen one of the patient's serious anxieties by a simple explanation of the brain's functions, illustrating his remarks by a sketch of the cerebrum. When, that night, the hallucination appeared in the darkness, there spread over the centre of it an image of the brain-diagram, which reassured him and brought him great comfort.

Though this is an extreme case, it illustrates the way in which spoken words may fail to affect certain individuals, not because the words are not understood, but simply because their appeal is in a medium which is under-developed in these particular persons.

### Auto-suggestion and the Verbaliser

It might be profitable to discover how far auto-suggestion, in that form at least which is recommended by M. Coué, may owe its success to peculiarities in the individual's imagery. Certainly one cannot decide from theory whether a person who habitually makes up his mind by means of words, using muttered or sub-vocal phrases as slips from which to launch his actions, is likely to find auto-suggestion more or less effective than the man who seldom or never " pushes off " from a word. For the latter, auto-suggestion might conceivably be very effective if the doctor's hetero-suggestion were so powerful as to make the patient adopt this, for him, violently unusual behaviour.

[1] Hallucinations the origin of which is attributed by the patient to his own mental processes, no objective reality being attached to them.

That auto-suggestion is successful to different degrees in different persons is well known, and it does not seem unlikely that different kinds of imagery may play a part in bringing about these varying effects.

That neglect of differences in predominant imagery has prolonged unnecessarily many controversies between psychologists, and others, seems certain. But the valuable and hopeful tendency to study behaviour in detail may lead to further misunderstandings if this elementary consideration is neglected. Mental tests and motion-study, two promising children of psychology, can easily develop the worst features of unmitigated "behaviourism" if they fall into the hands of unreflective workers. This and other risks will be lessened if it be borne in mind that the world of personal experience, expressing itself through behaviour—of which the use of words is only a particular example—is different for different people. At the back of our words, public property as they are, there is a mental region which in different persons is differently deep and broad, differently filled, and lighted with a different brightness.

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# The Treatment of Tuberculosis

THERE are two plagues of the human race, well recognised from the earliest times, which up to the present day have scarcely been influenced in any degree by all the efforts of the physician and the research-worker. Cancer and tuberculosis still remain among the "captains of the men of death"; the one a scourge of maturity, the other perhaps the more terrible, since tuberculosis is the disease of youth and the fullness of life. It seems established that each one of us has at some time suffered from it, and recovered; and that certain strains among our mixed population are more prone to succumb to its ravages than others. Above all, it is certain that consumption, or tuberculosis of the lung, is a disease greatly encouraged by modern town conditions—bad light, bad ventilation, and bad feeding. By careful attention to these points in a sanatorium, we can restore to health a patient who has come from a slum district, a victim to the disease. And then we can only return him to the conditions which caused his original ailment, and which will cause it again.

The cure, then, of consumption must always be a secondary object to its prevention. But that prevention can only be ensured when, in some distant Utopia, all men live healthy lives in healthy conditions, as much of their own choice as from opportunity. Meanwhile, the problem of treatment is ever present and every new method is of urgent interest.

## Tuberculin

Professor G. Dreyer has recently published the results of some early applications of a new treatment, which bid fair to open the way to considerable advances. In order to understand the theory of its action, it is necessary to go back to the greatest discovery of recent times in this connection—the isolation of the bacterium of tuberculosis by the German scientist Koch in 1882. It is a very narrow and short thread-like organism, only half the size of a red blood corpuscle, and it is one of a very small group of bacteria which are surrounded by a fatty envelope. The bacillus which causes leprosy is similar in this respect. From the point of view of the bacteriologist who is called upon to identify the orgarism in a patient, its most important characteristic is that, while it can only be "stained" by very strong dyes, it retains its colour even when acids are poured on it.

When the bacterium enters the human body it calls up a response of all the tissue which tends to slay it, and to neutralise the poisonous products which it excretes. Koch tried to increase this curative effort of the body by means of injections of an extract of the bacterium in glycerine. He prepared a series of such injections, known as tuberculins, which differed from each other in some minor respects. In theory they were identical—he wished to induce the body to produce its own medicine in large quantities, by injecting the poisonous substances which caused the disease.

The great hopes which were inspired by the introduction of this new cure, coming from the first authority on the subject, were destined to disappointment. Many cases were made much worse; a violent reaction followed injection, including great swelling at the site of injection and an increase in the fever and general symptoms. In fact, the reaction of the body to the bacterium consisted in strangling it by surrounding its colonies with fibrous tissue, and the effect of injec-

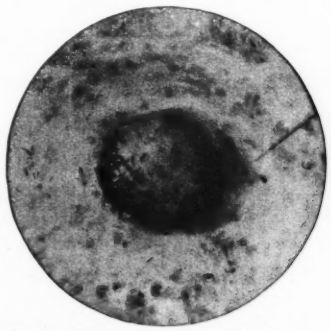
tion was often only to break down this barrier. Eventually the only use to which tuberculin came to be put by most practitioners was as a test of the presence of the disease, since the swelling at the site of injection only occurred in those who were suffering from tuberculosis.

## The New Dreyer Treatment

Professor Dreyer's method is, in theory, a similar one. He aims at stimulating the body to manufacture

A CULTURE OF THE BACILLUS OF TUBERCULOSIS.

substances capable of slaying the tubercle bacillus and neutralising its poisonous products. But instead of glycerine extracts or similar preparations, he dissolves off the fatty envelope surrounding the bacterium, leaving it a naked ghost of its former self. It is this fatty envelope which is responsible for the capacity of the bacterium, when "stained," to resist decolorisation by acids, and for long the power of resisting all curative measures which have been tried has been attributed to its protecting cover. An interesting fact relating to this feature of the bacillus is alluded to in *The Lancet* for June 30, 1923. A certain caterpillar which infests beehives has great powers of digesting wax, on which it lives. If preparations of the bacillus are injected into it, they are absorbed in a very short while, without any ill effects to the caterpillar.



THE TUBERCLE BACILLUS IN THE TISSUES OF THE BODY.
*From "Bacteriology and the Public Health," by Sir George Newman, M.D., F.R.S.E. (John Murray.)*

Professor Dreyer's is not the only preparation of the bacillus of tuberculosis without its coat which has been produced. In 1918 Dostal and Sahler published an account of their successful efforts to remove it, by growing the bacillus for several generations on a special nutritive substance. Professor Dreyer's method is to dissolve off the fatty coat with chemicals—formalin and acetone.

Tuberculosis is a chronic disease, and temporary improvement, as well as the typical optimism of the patient, have often prejudiced observers in the past in favour of new curative measures. There have been, for example, periods when consumptives were submitted to every variety of pungent oils—garlic, cinnamon, and eucalyptus—with the object of suffocating the bacillus; more recently considerable claims have been made in favour of the Spahlinger treatment, which is said to be capable of application as a measure of prevention as well as a cure. But the great test of a cure in tuberculosis is whether a guinea-pig, infected with the bacillus, improves under the treatment. No guinea-pig, however garlic-haunted, has ever been cured; the Spahlinger treatment is still *sub judice*; Professor Dreyer's injections have definitely improved the condition of such guinea-pigs. A few cases of human beings have been treated also. It is said that the results give great cause for encouragement. Patients with tubercular glands have done particularly well.

The times are peculiarly ripe for a great attack on this fatal disease. Of its own accord—perhaps on account of a widespread improvement in the conditions of life—tuberculosis is decreasing in danger. Fewer cases are reported year by year, and the deaths due to it have greatly diminished in number. But the infection remains with us; every uncured case is a danger to others. Arrangements are being made to test Professor's Dreyer's remedy on a large scale, and the results will be of the greatest interest.

Although the tubercle bacillus has received the greatest attention in this matter of fat-removal, the prospects opened by the discovery are not confined to it. Other bacteria—notably those which cause abscesses and are known as streptococci—contain fats, which can be dissolved away. Dead bacteria have long been injected, in the form of "vaccines," to produce a general effort of the body and to overcome infection from these organisms. The removal of the fat appears greatly to increase the potency of vaccines, while preventing certain uncomfortable features. In fact, it is possible that we are on the brink of some of the most important advances of the century in the

treatment of diseases due to infection by recognised bacteria.

R. J. V. P.

An article which readers are well advised to refer to in conjunction with the above notes is "Immunity in Infectious Diseases," by Professor A. E. Boycott, DISCOVERY for March 1922, p. 66.

# New Light on Old Authors

## V. Where was Vergil Born?

**By R. S. Conway, Litt.D., F.B.A.**

*Hulme Professor of Latin in the University of Manchester*

"WHY, at Mantua," most school-boys would answer, if they saw the question in this title. And they would be right. But when they reflected that his father was a farmer, that Mantua was a town, and that a farm, especially a large one, cannot very well exist on ground occupied by bricks and mortar, they would see that their answer did not go far enough. They would realise this still more if they had learnt that the whole surface of ancient Italy was divided into what we should call "townships," although the actual towns were often as much as fifty miles or more apart. For instance, a glance at the map (Fig. 1) shows that more than one of the four towns, Brescia, Verona, Cremona, and Mantua, however the area of the quadrilateral of which they made the corners may have been divided, must have reckoned as its own a good deal of land which was many miles removed from its centre.

The point, then, of the question which we are asking is this: in what part of the country round about Mantua did Vergil live? This would not matter very much if the districts on all sides of Mantua were alike. But since, as we shall see, there are great differences in the nature of the country, the actual situation of Andes, which was the name of Vergil's village, probably did matter a good deal to Vergil himself. After all, most people would have a rather different outlook on life if they lived in sight of Snowdon from that which they might have if they lived in the Fens of the Eastern Counties.

### The Traditional Site

But perhaps some readers of this article may be prepared to say more than a school-boy would, and may reply that they know, or possibly even that they have visited, a site which is commonly believed in Italy to be that of the ancient Andes, namely a little hamlet called Pietole about two English miles S.E. of Mantua. If they have been there, they will no doubt have seen the handsome monument erected to Vergil's memory some years ago on that spot; and they will understand the feeling of a living citizen of Mantua who, when he read in the Milanese papers last winter some account of the discovery with which this article is concerned, wrote to his local journal in Mantua denouncing the follies of wandering professors who would leave no well-known doctrine undisturbed, and concluding pathetically with the remark that he had been Chairman of the Committee which had erected that monument and so of course he must know! There is this much to be said for him, that the tradition which places Andes in Pietole has prevailed in Italy ever since the time of Dante, who in one passage shows that he believed it; but it has been frequently questioned, and of late years more and more doubted, by scholars outside Italy. It would take too long to examine what little ground there may have been for such a tradition; all that can here be said is that the evidence, though it was enough to give rise to a popular notion that Pietole was the site, was far from being enough to justify it.[1]

### Why is the Tradition Wrong?

But perhaps the reader may say, even if he is interested in Vergil's poetry, that after all, wherever Vergil lived, it is rather late in the day for us to trouble about it. Why should we not be content to enjoy his poetry without wanting to inquire more precisely where he was born? The answer is that if we accept the tradition which places his home in Pietole, we have not only to disregard his best biographer—a scholar called Probus, who lived in the first century A.D. and who tells us that Andes was thirty Roman miles, that is twenty-eight English miles, from Mantua—but also to make a considerable part of Vergil's own poetry, and that the part which tells us most about his own experience, quite unintelligible. For we have then to suppose, as we shall soon see, that when he described his own home, he wrote many lines of mere nonsense, to call it by no harsher name.

### The Background of the Eclogues

This indeed the commentators admit. One of the best of them tells us that the neighbourhood of Mantua

[1] The evidence consists only of a copy of a fragmentary inscription which, if it ever existed, must have been put up in honour of some member of the Vergilian family. Mommsen thought that the inscription was a forgery. But as the stone, if it existed, has entirely disappeared, it is difficult to say whether he was right; and even if he was wrong, we have no means of telling whether the date at which the inscription was set up was near the time of Vergil.

"does not suit the description of scenery in Vergil's Eclogues." Now taken by itself this criticism is like saying that the description of scenery in Shakespeare's plays does not "suit" the neighbourhood of Stratford-on-Avon. The Eclogues are essentially dramatic; and to criticise their author because the scenery which they mention appears to you different from the scenery of a particular part of a particular country, is just about as helpful as it would be to criticise Macbeth because he did not meet the witches on the banks of the Avon, or Hamlet because his father's ghost did not appear (say) on the battlements of Kenilworth Castle! It is obvious that we must inquire what is the background implied in each separate Eclogue before we can judge whether it is or is not consistent. In the Second Eclogue, for example, the speaker expressly declares that he has "a thousand sheep wandering on Sicilian mountains"; therefore they must be in Sicily; therefore it seems hardly worth while to complain that they are not in Mantua! The scene of the Eighth Eclogue is wholly Greek; the Sixth and the Tenth follow Vergil's friend Gallus over the whole poetical world, taking, so to speak, snapshots of Gallus's poetry, now in Arcadia, now in Thrace, now in Crete, and now in the unknown region where Pyrrha [and Deucalion threw the stones from which, according to the fable, mankind was recreated after all but they had perished in the Deluge. And finally we have the Fourth Eclogue, which sets out to prophesy a new world and ascribes to it all the riches of every known land. It is clear, therefore, that in these five Eclogues the question of local scenery simply does not arise.[1]

But what the critics, no doubt, do mean is this: that in the Eclogues where reference is definitely made to North Italian conditions, for instance in the First, they have been unable to discover any points of scenery which they can identify with what they have seen in the neighbourhood of Mantua. How far they have explored the region of Mantua they do not say.

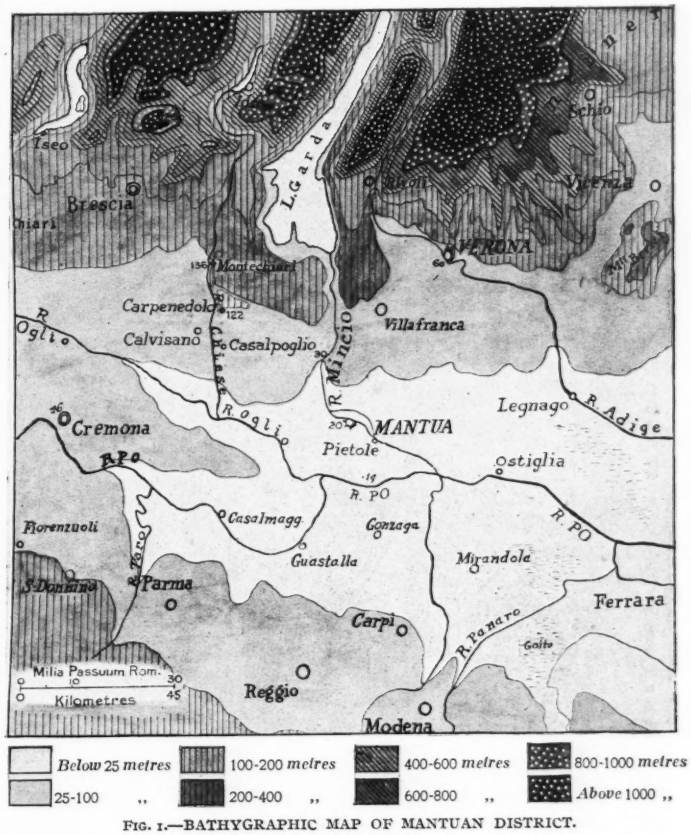



FIG. 1.—BATHYGRAPHIC MAP OF MANTUAN DISTRICT.

## The Local Eclogues

Of the other five the First and the Ninth tell us, in poetical fashion, how Vergil came to lose his farm.

[1] The reader will perhaps notice that the numbers of these non-local Eclogues are all even (2, 4, 6, 8, 10). This cannot be an accident; Vergil, in his silent way, has chosen from his early poems five with a local setting and five in other scenes, and arranged them alternately.

These two we shall have to examine carefully. The local references in the other three (Third, Fifth, and Seventh) are obvious, for example, in the Seventh, the mention of the River Mincius (which flows round Mantua), and in the Third, of the statesman Pollio, governor of Cisalpine Gaul at the time. The Fifth has been shown to be an allegorical lament for the death of Julius Cæsar; and one of the persons in it, by name Menalcas, claims to be the author of the Second and Third. The question, then, which concerns us is whether it is true that the scenery described in these five Eclogues is unlike anything to be found in the region of Mantua. If this is true, Vergil has made a sad mess; and this is what some of his critics seem to take particular pleasure in supposing. Let us see whether they are right.

## Why did Vergil lose his Farm?

Save for the mention in the Third of streams closed by sluices, and the frequent mention in all the five of hills, and of nooks in the hills for shelter from the heat, we need not here consider anything but the

two Eclogues concerned with Vergil's farm. In the First we learn that the farmers of the district generally have been turned out to make way for soldiers who have been fighting in the Civil Wars. One named Melibœus has just been evicted and takes a sad leave of Tityrus, who has been permitted to remain in his farm because he went to Rome and secured the favour of a gracious young ruler. There has never been any doubt that by this young ruler Vergil meant Octavian, who seems to have done his best to protect the poet.

FIG. 2.—THE SO-CALLED FONDO VERGILIO AT PIETOLE.

But why were the farmers round Mantua being turned out? Because the troops of Antony, in the year after the battle of Philippi in 42 B.C., in which they had helped to defeat Brutus and Cassius, demanded that Antony and Octavian should fulfil the promises which they had made of liberal pensions. (At this time Vergil was twenty-nine years old.) Now the only form of military pension which the Romans knew was a grant of land, and to these soldiers land had been promised in North Italy. For this purpose the territory of Cremona, a town which had offended Antony, had been entirely confiscated. But even so there was not enough, and a great part of the land of Mantua was seized also. This is indicated in the Ninth Eclogue, in which we learn that Mantua had suffered because it was "too near a neighbour to unhappy Cremona." And this same passage shows that Vergil himself (for "Menalcas" in this poem means Vergil, as Quintilian tells us) finally had to leave his farm, though it seems clear also that Octavian had not left him in want.[1] One of the speakers says that he had heard that Menalcas had saved his property by his poetry; but the other replies that the report was untrue, and that in fact both Menalcas and his servant had barely escaped with their lives. Nevertheless the poem goes on to other subjects, and seems to describe Menalcas as being in a fairly cheerful condition and expecting to "sing better songs," that is to write more ambitious poetry.

## His Description of the Farm

Now in the course of the story, as it appears in the

[1] Not long afterwards we find him in an estate near Naples, given to him by his friend Mæcenas, the wealthy minister of Octavian.

conversations, we have a good many descriptive points. There are three separate pictures in the First Eclogue. One is of the scene in which the conversation takes place : Tityrus is lying in the shade of a spreading beech-tree, and at the end he points to the smoke rising from farmhouses in the distance as a token that evening is near, since the people in them are preparing supper ; and he also points to the " lengthening shadows " of the " high mountains." We gather also that both of the shepherds live within reach of some small town where they used to take their produce for sale. But the way in which this expedition is described in Eclogue IX seems to show that the town was a good day's journey from the village

The second picture in the First Eclogue is of the farm which Melibœus, a neighbour of Tityrus, has to leave. One of the things which he will no longer be able to do is to lie in a " green cave " or recess and watch his sheep on a bushy slope some way off, on which, while they browsed, they seemed to be " hanging by their feet "—a pretty and exact description of the appearance of sheep on a steep hillside.

The third picture is of the farm of Vergil himself. This is described modestly enough. Melibœus says to Tityrus, who in this Eclogue represents Vergil, that it is quite " big enough " for him, however much it may be " cumbered with bare stones or muddy reeds." And we learn further that it had a willow hedge beloved by the bees, a tall elm haunted by pigeons and turtle-doves, and a cliff under the shade of which the vine-dresser could rest and " sing to the breezes." Other lines tell us of pine-trees and more than one stream ; " familiar rivers and sacred springs." To this the Ninth Eclogue adds, in the lines just noticed, that the estate which Vergil lost ran some distance from the point " where the hills begin to withdraw, and let their ridge sink into the plain by a gentle slope, right down to the water and to the group of beeches, once tall trees, now broken with age." These " ancient beeches " appear also in the Third Eclogue. It must have been a spot which made some impression on Vergil's boyish mind, partly, no doubt, because it marked the end of his father's farm.

From all this it is clear that Vergil meant his readers to think of the farm as being in (or quite close to) hilly country, with steep pastures, caves or nooks in the hillsides, cliffs, rivers, and freshly running springs.

## Was it Pietole ?

The defects which critics have felt will be easily understood from a glance at a photograph of Pietole (Fig. 2). The country there is flat ; or, to speak quite strictly, it loses in height above sea-level one metre in a distance of nine English miles, the distance from Mantua to the nearest point of the River Po. Pietole lies just on this line ; and when we consider that Mantua itself lies between two great lagoons, we realise that there is always plenty of water in Pietole, but that it is practically stagnant, since the fall is so slight. The whole country, in fact, is a mere network of dykes and ditches, its only other feature being monotonous rows of willows and tall, lean poplars. Nothing like a hill can be seen ; Pietole is more than thirty miles in any direction from the nearest. And if there were such a thing as a cave or recess to be found, it could only be a kind of rat's-hole in the hollow bank of a large ditch. The photograph of the supposed farm of Vergil at Pietole makes this clear ; and it makes clear also that if Vergil's home was at Pietole, he must have indulged an audacious imagination in describing it as we have seen he does.

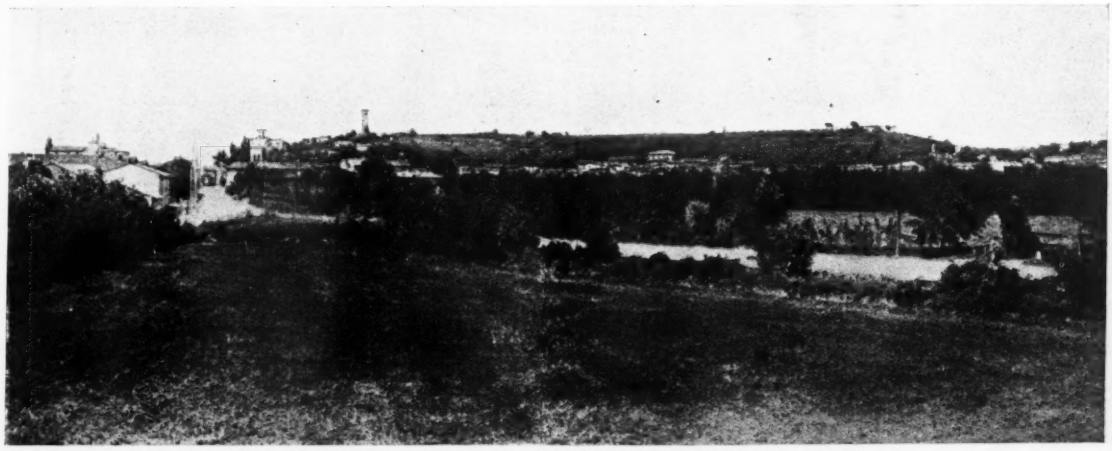


FIG. 3.—THE RIDGE RUNNING EAST FROM CARPENEDOLO.

## The New Evidence

In 1915 Mr. G. E. K. Braunholtz, in the course of a long study of the inscriptions of North Italy, and especially of the names of places and persons, pointed out that at a place called Calvisano there was an inscription (whose lettering suggests that it was cut in, or soon after, the Augustan period) set up by a member of the Vergilian family; and that at another village, only seven miles off, there was another inscription set up by one Publius Magius, that is, by a member of the family of Vergil's mother, or at all events of a family with the same name. The lettering of this inscription also belongs to precisely the same period (say from 50 B.C. to A.D. 100). He further pointed out that Calvisano, where the first inscription (on an altar dedicated by a lady called Vergilia) was found, was exactly at the distance from Mantua, namely thirty Roman miles, which, as we know from Probus, Vergil's birthplace, Andes, was. Now these coincidences (of names, time, and place) seem too remarkable to be due to accident; and they certainly indicate the neighbourhood of Calvisano, which lies on the road from Mantua to Brescia, as a neighbourhood in which it is at least possible that members of Vergil's family once lived. Of course the Vergilia mentioned in the inscription could not be the poet's daughter, since he was never married; she might have been a sister, though his biographers, in their meagre records, mention no such relative; there is nothing, at all events, to prevent our supposing that she was a niece or cousin who lived near enough to the temple of the *Matronæ* (mother-goddesses) at Calvisano for that to be the most natural place in which she could offer a vow for the health of another lady (probably her daughter) as the inscription tells us she did.[1]

## Calvisano and Carpenedolo

The question now before us is clearly this: Does the scenery of Calvisano suit Vergil's description of his own home? In June 1922, and again last February, I did my best to settle this question by visiting the district. Calvisano lies between the rivers Chiese and Mella,[2] five English miles W. of the ridge of Carpenedolo.

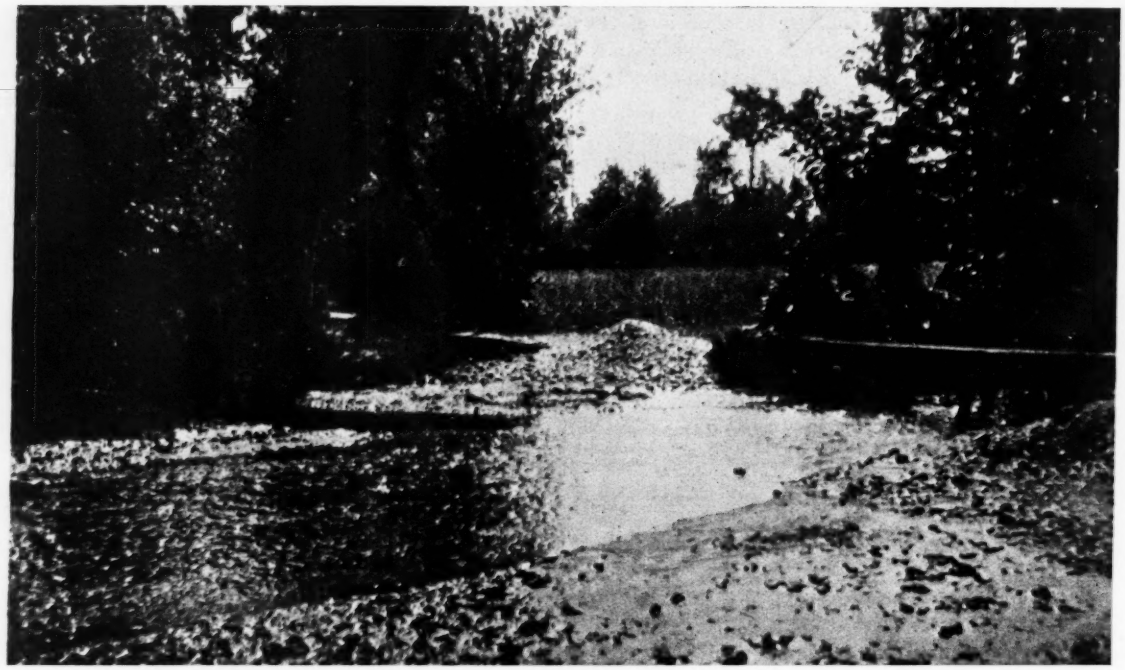


FIG. 4.—ROADSIDE STREAM, SOUTH OF CARPENEDOLO.

[1] It runs thus, on the face of an altar, which itself was the object vowed: *Matronabus Vergilia G(ai) f(ilia) Vera, pro Munatia T(iti) f(ilia) Catulla v(otum) s(olvit) l(ibens) m(erito)*. "Vergilia Vera, daughter of Gaius, having received an answer to her prayer for Munatia Catulla, daughter of Titus, gratefully pays her vow." If these two ladies were mother and daughter, the husband of the first and father of the second must have been called Titus Munatius.

[2] This lovely stream is the only one of the small rivers of North Italy mentioned by Vergil in the Georgics (iv. 278), and it is there mentioned, as Mr. Mackail has reminded me, with a special note of familiarity and affection.

This ridge runs beside the River Chiese for some distance from N. to S. and then, turning E., "sinks into the plain by a gentle slope." This is the first visible hill you encounter as you go from Mantua to Brescia. In other words, it is the last outpost of the Alps in the direction of Mantua. Fig. 3 is a photograph of the ridge at Carpenedolo which shows how it melts into even ground. In this ridge there are no caves, strictly speaking; nor can there be in this whole region S. of the Alps and N. of the Po, where the only hills are those made by the great heaps of broken rock and rubble (moraines, as we call them in the Alps) left long ago by the glaciers of the last Ice Age, but now covered with green. But there are a number

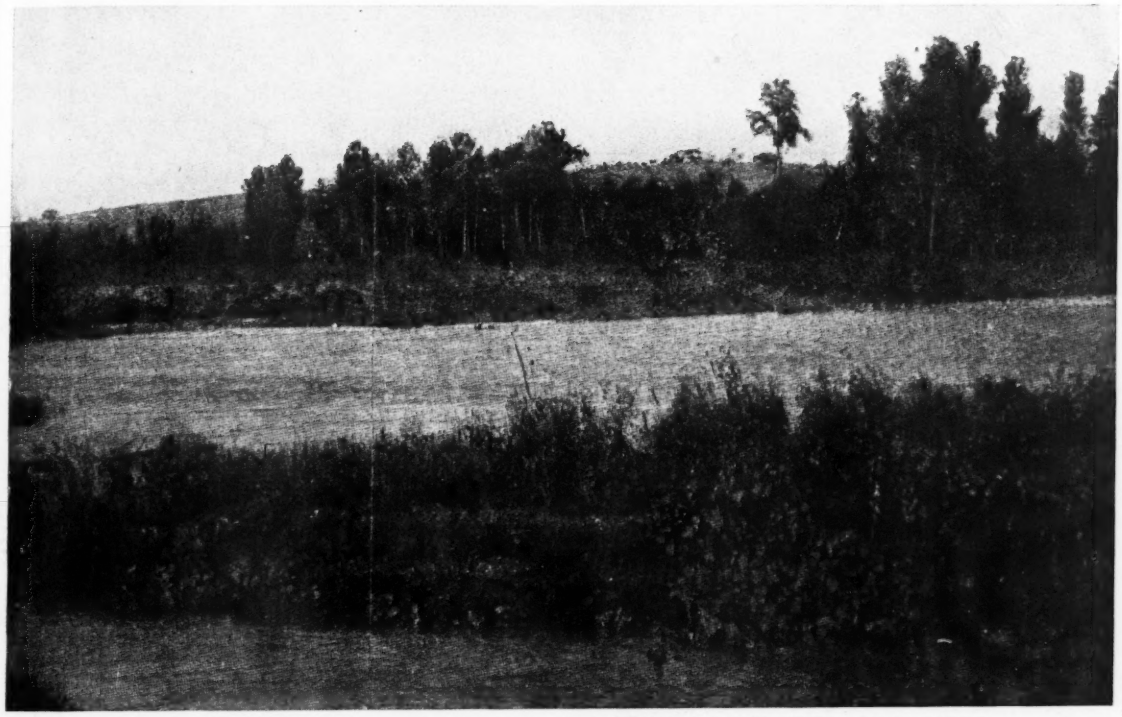


FIG. 5.—THE CHIESE NEAR CARPENEDOLO, WITH THE NORTHWARD ARM OF THE RIDGE BEHIND.

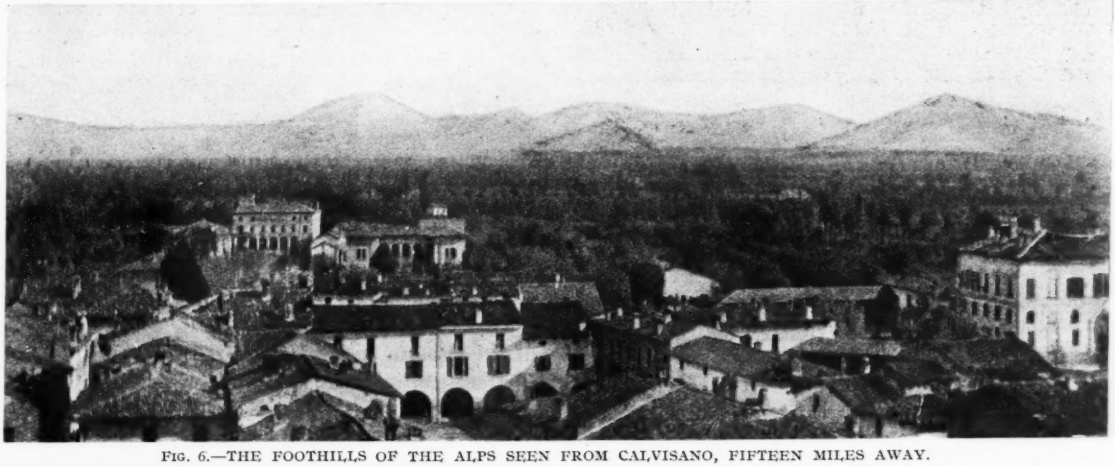


FIG. 6.—THE FOOTHILLS OF THE ALPS SEEN FROM CALVISANO, FIFTEEN MILES AWAY.

of niches and recesses in their steep and often broken slopes which give plenty of shelter from the midday sun, and which afford a view of the steep grassy side of the next hillock. And there are many perpendicular scarps where the side has, at some time or other, been sharply cut away, which, from a little distance, look like cliffs, and which would certainly give plenty of shadow.

Fig. 4 is a photograph of one of the wayside streams just S. of Carpenedolo, which shows how quickly the water runs over the pebbles, utterly unlike the stagnant ditches of Pietole. And the reason for this is obvious, namely that in the 27 English miles between Carpenedolo and Mantua the water has to fall more than 100 metres, that is to say, more than 330 feet, which is a very different thing from 1 metre in 9 miles. Some of these little running streams have sluices in them to hold up the water in a pool whence it can be diverted into the meadows by the side, as the last line of Eclogue III describes.

The last pictures are of the spot on the ridge of Carpenedolo with the River Chiese in front (Fig. 5), where it seems to me likeliest that Vergil's farm stood, and another (Fig. 6) showing the view of the lower Alps, rising sharply (see the map) behind Brescia, which are always visible from Calvisano. On a certain number of specially clear days in the year the great snowy heights of the Adamello group are themselves visible behind; and when they are not visible, they are always covered by a great mass of torn and broken cloud which lends to the distant view just such an element of mystery and wonder as lovers of Vergil know to be the most characteristic thing in all his descriptions of nature.

Full authorities for the statements contained in this paper, in which a good many disputable matters have been treated with brevity, will be found in a paper published in the *Bulletin of the John Rylands Library* (vol. vii, January 1923) under the title, "Where was Vergil's Farm?" I thank my colleague, Mr. W. A. Gould, B.A., cordially for the trouble he has generously taken in preparing the map.

# Modern Industries—III

## Brick-making in the Midlands

**By R. C. Skyring Walters, B.Sc., Assoc.M.Inst.C.E.**

THE object of this paper is to describe the brick-making industries of the Midlands, in particular that of the district between Peterborough and Bedford. In this district are situated, perhaps, the largest establishments in the country for making ordinary common building-bricks, known as "Flettons"—the origin of such works being due to the presence here of clay known as the "Oxford clay," which is particularly well suited both as regards quality and quantity for the manufacture of bricks.

The criterion for a clay which will be suitable for making ordinary common bricks is not easily defined, as a *pure* clay (which contains about 40 per cent. of alumina, 50 per cent. of silica, and 10 per cent. of water) is unsuitable for brick-making; and comparatively little is known of the impurities found in natural clays which go to make up a good brick. Chemically, brick-making is not an exact science, for neither the chemical arrangement of the oxides, alumina and silica, nor the effect of the impurities in a clay upon its physical properties, such as its plasticity when moistened, nor its behaviour when calcined, nor its variable colour, is fully understood.

But it is definitely known that brick-making material has been originally formed from the decomposition of rocks, such as granite, which contain felspar (the opaque constituent of granite), the potash or other base of the felspar having been taken away and the alumino-silicic acid,[1] i.e., clay having been left. It is known that the presence of sand in clay tends to prevent the clay from shrinking when burnt, raises the temperature required for burning, and reduces plasticity; whereas the presence of lime in a clay causes shrinkage, a lower fusion-point, and an increase in plasticity. Hence chalk may be added to "lean" siliceous clays; and, on the other hand, sand to "foul" or very plastic limy clays. Ferric oxide induces the red colour; magnesia, the yellow. Iron pyrites tends to split, and certain salts tend to warp or twist or melt, the bricks when they are burnt, and these salts are therefore detrimental.

In short, the known chemistry of clays for brick-making is at present not unlike that of cement some thirty or forty years ago, and there is no doubt that ere long chemists will discover as much about the chemical reactions that occur when a piece of clay is burnt as they know to-day of the reactions between chalk and clay when they are calcined together for making cement. At present the best test for a brick-clay is its trial under the conditions under which it is proposed to be manufactured into bricks on a large scale.

There are, however, certain physical and mechanical properties of a suitable brick-making clay which may be recognised in the field. A suitable clay—

(1) Must be of uniform material, colour, and texture, without patches of chalky or limy material (such as is contained in many drift-clays). Such lime may also be in the form of hard nodules, pebbles, fossil-

[1] Alumino-silicic acid contains about 40 per cent. of alumina, 46 per cent. of silica, and 14 per cent. of water.

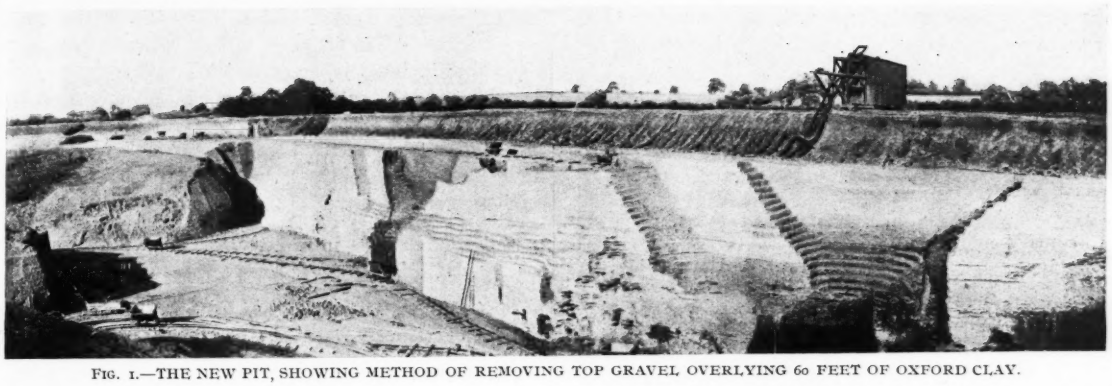


FIG. 1.—THE NEW PIT, SHOWING METHOD OF REMOVING TOP GRAVEL OVERLYING 60 FEET OF OXFORD CLAY.

shells, stones, which are all objectionable in varying degrees according to their quantities.

(2) Must not be too plastic or "foul"; such a clay would shrink or crack on burning. The appearance of lime would indicate such a clay.

(3) Must not be too "lean," i.e. it must be plastic enough to hold together during the process of drying; the appearance of grains of sand would indicate such a clay.

The Oxford clay, called "Knotts" in the district under consideration, approximates very nearly to the above ideal conditions. The clay is dug in large open pits some 60 to 80 feet in depth, upon which there lies superimposed a stratum of some 5 to 12 feet of gravel or of clay containing numerous glacial stones and boulders. Fig. 1 shows a common method of removing the top deposit, which is loaded into tip-wagons and deposited into a neighbouring pit from which all the clay has already been dug. The clay itself is won by means of steps (Fig. 2) on which the men work with crowbar, pick and shovel; and the clay is sufficiently hard to stand, winter or summer, without subsiding or falling; and although some of the quarries are upwards of 80 feet deep, the men work on the ledges with perfect safety. Fig. 2 also shows the steep inclined cutting made in the maiden clay to act as a shoot for the material, with the tip-wagon at the bottom ready to receive the spoil. The floor of the quarry is at (or near) the stratum of Kelaways Rock, which forms a comparatively hard and dry working floor. It is not, however, everywhere in the district that such good conditions prevail; locally the top gravel-deposit or "callow" varies remarkably, and the local geology has to be known in detail in order to determine the best sites for sinking new pits; in one quarry it was found that a glacier or a river had scooped out more than half the Oxford clay and redeposited in its stead a silt, containing stones, gravel, etc., which material was quite unsuitable for brick-making. Hence the quarry had to be abandoned at considerable loss.

From the pits of this district have come some of the famous fossilised saurians, collected by Major Leeds, which are now housed at the British Museum,

FIG. 2.—SHOWING METHOD OF WINNING THE CLAY WITH STEPS AND SHOOT IN FOREGROUND.
The tramway incline and works in background.

South Kensington. Two or three galleries are devoted to the collection which is known as the "Leeds Collection."

It is unfortunate for the geologist and fossil-collector that the method of quarrying, shown in Figs. 1 and 2, except in the deepest of pits, is fast disappearing

because it is more costly, and that the cheaper method for winning the clay, shown in Fig. 3, is now coming

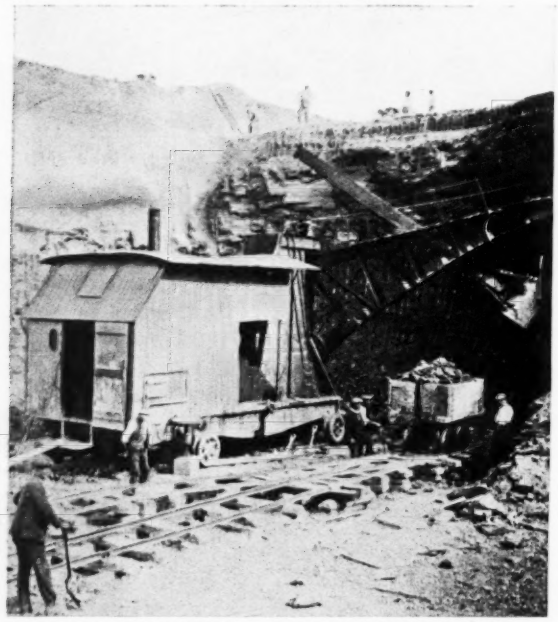


FIG. 3.—SHOWING ANOTHER METHOD EMPLOYED, I.E. GETTING THE CLAY BY MECHANICAL DIGGERS.

into general use. By this method fossils are broken up and the vertical face cannot be inspected so easily.

The clay is dug by mechanical diggers and is loaded into tip-wagons, which are drawn up a steep incline, such as is shown in Fig. 2, to the grinding-mills, which are somewhat similar to mortar-mills. It is unnecessary to add any material such as lime or sand, and usually it is unnecessary to add water, the clay itself being sufficiently moist, though not too moist; most important of all, the clay may be used as soon as it is dug, and need not be stacked in the open for some weeks or months to mature, as is the case with some clays. After being ground and passed through sieves, the clay is sent to the pressing machines and, with a die, is pressed into bricks measuring $9 \times 4\frac{1}{2} \times 3$ inches. These are removed by barrows and stacked in the large modern Hoffmann continuous kilns (shown in Fig. 2)—very familiar objects in some districts. In these kilns the bricks remain for some three weeks, their size being reduced by burning to $8\frac{3}{4} \times 4\frac{1}{4} \times 2\frac{5}{8}$ inches.

The kiln is divided into some sixteen compartments in one of which the green, undried bricks are stacked. Flues and dampers communicate with each compartment, and from each compartment with the chimney. Feed-holes in the roof of each compartment are also provided By these devices the hot gases are drawn forward from a compartment in which bricks have been burnt, and introduced into a forward compartment for drying the green bricks. When these are dry, further heat can be introduced, and increased by the use of fresh fuel for burning them. For this purpose a high temperature is required. When the bricks have cooled sufficiently, the compartment is emptied and becomes again available. From this it will be gathered that there is always fire in some part of the kiln and that it goes round in one direction; hence the name "continuous" kiln.

The total output from the works round Peterborough is of the order of 8,000,000 to 10,000,000 bricks per week under normal trade conditions.

# Animal Fecundity—I

**By F. H. A. Marshall, Sc.D., F.R.S.**

*Reader in Agricultural Physiology in the University of Cambridge*

THE variation in fecundity (i.e. in quantity of offspring) in different species was explained by Herbert Spencer in a generalisation which he applied to man as well as to the higher animals. He supposed that the capacity to sustain life and the power to produce new individuals are, roughly speaking, in inverse proportion, an idea which was summarised in the dictum that Individuation and Genesis vary inversely. Amid favourable surroundings and in the presence of abundant easily obtained food the necessary expenditure of energy by the individual is relatively slight; in other words, the cost of Individuation is low, and in such conditions the rate of Genesis is correspondingly increased. Spencer cited the Kaffirs, the Boers, and the French-Canadians as examples of races fertile among men in which the rate of increase was associated with a nutrition much in excess of the expenditure of energy necessary for maintenance, and he contrasts the fertility of these races with that of others amid less favourable conditions.

## Less Propagation among Active Animals

Among animals there are countless examples illustrating the same principle. Spencer cited the hare and the rabbit as species closely allied and living on much the same food, but differing in the amounts of energy spent on movement. The relatively inert rabbit may have six young at a time and four litters a year, whereas the more active hare has a smaller number of young in a litter and fewer litters. Moreover, the rabbit begins to breed when six months old, but the hare not until it is a year old. Thus the fecundity of the rabbit as compared with that of

the hare is greater than could be explained if account be taken only of difference in size.

Again, the bat as a rule bears only one offspring at a time, and is thus unusually unprolific for so small an animal; and this is ascribed by Spencer to the relatively high rate of expenditure resulting from the habit of flying. He pointed out, further, that in comparing birds of various species with mammals of the same size and weight, the creatures which are continually going through the exertion of sustaining themselves in the air, and propelling themselves through it, are less prolific than those whose movements are restricted to the surface of the ground. Other instances of the application of the same principle are supplied by the domestic animals which, with few exceptions, have larger and more frequent litters than wild animals belonging to the same species. Thus the tame rabbit will breed six or seven times in the year and may have as many as eleven young in a litter. The domesticated ferret is far more prolific than the polecat, which is its wild prototype. The domestic sow breeds regularly twice a year, and sometimes even oftener, and has remarkably large litters, whereas the wild sow breeds less frequently and produces fewer young at a time. The wild sheep has only one young one and a single mating season, while the domestic sheep frequently produces twins or triplets, and, as long ago Aristotle observed, "where the weather is warm and fine and food is abundant may have lambs twice a year."

These and other examples of the same principle are noted by Darwin, who attributes the increased fertility of the domestic animals to a long habituation to a regular and copious food supply without the labour of seeking for it. In a similar way Spencer accounts for such well-known facts as that hens cease to lay when they begin to moult—"While they are expending so much energy in producing new clothing, they have nothing to expend for producing eggs." All these are examples of the more general principle that the energy developed in the body manifests itself in a variety of ways of which the power to procreate is only one. A more special application of the same conception as applied to man, and one that has come into prominence through the teaching of a modern school of psychology, is that sexual energy, instead of being ill-spent or dissipated in unnecessary propagation, may sometimes be more usefully diverted into profitable intellectual channels.

There are, of course, many exceptions to Spencer's law of the inverse relation between Individuation and Genesis (for example, the fact that wild animals, even when tamed and not confined, will often refuse to breed); nevertheless, as a general descriptive statement of the observed facts of nature it represents a true conception, at least so far as the higher animals are concerned. But the ways in which conformity to the law is observed are diverse, and in view of the importance of the subject, not only theoretically but also practically (in relation to man's control over the fecundity of the domestic animals), it is well worthy of study.

## High Rates of Propagation

It might at first thought be supposed that an animal's capacity to procreate was controlled mainly by the number of ova or eggs produced by the female, or the number of corresponding reproductive cells (called sperm cells or spermatozoa) given off by the male. In the lower animals this supposition is in a sense correct, for of the total number of eggs produced, say, by a fish, probably the majority are actually spawned, and here the actual fertility is regulated by the number of eggs which become fertilised, and which, escaping the many dangers to which they are subject, are able to complete the process of development. Thus it is stated that the female cod spawns six million eggs, of which considerably less than a third are afterwards fertilised. In the higher animals, however, as well as in many of the lower, only a certain proportion of the potential eggs produced by the ovary or female reproductive gland ever reach maturity at all, and a still smaller percentage are released from the organ so as to obtain a chance of becoming fertilised and developing into new individuals. The late Professor Francis Maitland Balfour, whose early death biologists have not ceased to deplore, showed long ago that in the higher animals one embryonic egg may develop at the expense of others, and that the eggs which disappear may serve as food material for the one ovum which, owing to a superior vigour or to some chance circumstance relating to its position in the ovary, was able to survive.

## Cannibalism among Eggs

Thus there is a veritable struggle for existence amongst the reproductive cells during the processes of development within the generative glands, and those cells which survive may do so by taking advantage of the death of others at a very early stage of existence. This fact has been particularly well shown in the freshwater polyp or *Hydra*, and other species belonging to the same class, for in the developing eggs of these animals the nuclei of other ingested eggs continue to be easily recognisable even after the surviving egg has become fertilised and has begun to develop. Similar observations have been made more recently by Dr. Janet Lane-Claypon on the developing ova of the rabbit, and phenomena of the same kind have been noted in other species of mammals. Dr. Arai has estimated that the female reproductive gland of the rat

contains at birth 35,100 ova, but that these are reduced by degeneration to 11,000 after twenty-three days, and to 6,000 by the sixty-third day. That nutrition must play an important part in regulating the proportion of eggs which survive and eventually become mature is a conclusion which is based on observation and not merely on inference. This is a matter which will be considered in a further instalment of this article, dealing with some of the factors which control fecundity in the domestic animals.

# Among the Stars—A Monthly Commentary

## Discovery of 850 New Nebulæ

In *Harvard College Observatory Bulletin*, No. 784, Dr. Harlow Shapley announces his discovery of 850 new nebulæ on a plate exposed on September 19 of last year, with an exposure of six hours. Dr. Shapley announces that these are "distinct nebulæ," the brighter almost without exception being elongated or spiral, while the fainter are mainly globular in shape. "At the eighteenth magnitude, on many parts of the plate, nebulæ are more numerous than the stars."

## A New Theory of the Spiral Nebulæ

Perhaps the most difficult problem in the whole realm of astronomy at the present moment is that of the nature and status of the spiral nebulæ. During the last decade, two main theories have been supported by strong observational evidence. These are (1) the older, or nebular, theory, the exponents of which regard the spirals as true nebulæ, comparatively near at hand as celestial distances go; and (2) the "island-universe" theory, whose supporters maintain that the spirals are galactic systems, situated at immense distances from our own stellar universe. Within the last year or two, the tide of opinion has begun to flow somewhat strongly against the island-universe theory, without giving definite support to its rival. At a recent meeting of the Royal Astronomical Society, Professor F. A. Lindemann outlined a novel hypothesis which is embodied in the society's *Monthly Notices*, April 1923, pp. 354–9. According to this theory the spirals consist of dust-particles, repelled from the stars by radiation pressure. "There must be a continuous stream of fine dust leaving the neighbourhood of the stars and moving towards regions of low radiation density." On this hypothesis, the very high velocities of the spirals are accounted for as a consequence of light-pressure, which may rise to eight times the gravitational attraction in the case of the sun, while "for stars radiating more per unit, it may be considerably greater." Dr. Lindemann further suggests that the light of the spirals is not inherent, but due to reflection from the light of the stellar system as a whole. His explanation of the appearance of novæ in the spirals—that these outbursts are due to encounters between spiral nebulæ and "comet-like clouds of stones or sand"—is, on his own admission, "somewhat artificial." The new hypothesis, which is not out of harmony with certain speculations of Dr. See and a tentative theory outlined by Dr. Shapley, is certainly worthy of serious consideration.

## A Stellar Mystery

The daily press reported early in May the discovery of a new star of between the fifth and sixth magnitude in the constellation Cygnus by Dr. Thomas D. Anderson, the Scottish astronomer, at Thurston Mains, Innerwick. Dr. Anderson detected Nova Aurigæ in 1892, and Nova Persei in 1901. A search at the great observatories, however, did not confirm the discovery. Professor Frost reported that visual and photographic observations made at the Yerkes Observatory on May 12 failed to show any nova near to the position assigned by Dr. Anderson, while Dr. Shapley reported that on several Harvard photographs showing stars fainter than the eleventh magnitude no nova could be traced.

AN EXAMPLE OF A SPIRAL NEBULA.
The great spiral nebula, M51, in Canes Venatici.
(*Photo by Dr. Max Wolf.*)

Various solutions of the problem have been put forward. Dr. W. H. Steavenson, at the May meeting of the Royal Astronomical Society, suggested that some confusion had arisen over the two stars 69 and 70 Cygni. "Some of the smaller star atlases show only one star in this region, so that either might well be taken for a nova." In a letter addressed to Sir Frank Dyson, dated May 15, however, Dr. Anderson reiterated his conviction that he had made no mistake, having seen 69 and 70 Cygni, as well as the nova. "That in the early hours of the 9th inst.," Dr. Anderson wrote, "a great stellar outburst was visible near 69 and 70 Cygni, I am as sure as that I am now sitting here at Thurston Mains writing this letter to you." "This Nova Cygni has certainly faded away, I admit, with miraculous rapidity; but if there are novæ which, like Eta Carinæ (Argus), take centuries to go through their evolutions, or like the great nova of 1572 take years, or like the majority of them take months, or like the Nova Coronæ Borealis of 1866 take six weeks, why may there not be stars whose temporary outbursts are ended within a few hours?"

Dr. Anderson's high reputation as an observer certainly militates against the possibility of a mistake on his part, so for the meantime the mystery must remain a mystery.

### A New Astrophysical Observatory

It is announced that the Australian Government has resolved to erect an astrophysical observatory near Canberra, the new federal capital. Two telescopes have been secured, and building operations are likely to start at an early date. The erection of another large modern observatory in the southern hemisphere will supply something that has been needed greatly during recent years.

HECTOR MACPHERSON.

# Reviews of Books

## ANTARCTIC ICE FORMATIONS

*British Antarctic (Terra Nova) Expedition* 1910–13. *The Physiography of the McMurdo Sound and Granite Harbour Region.* By GRIFFITH TAYLOR, D.Sc., etc.

*Glaciology.* By C. S. WRIGHT, M.C., M.A., AND R. E. PRIESTLEY, M.C., B.A. (Harrison & Sons, for the Committee of the Captain Scott Antarctic Fund.)

No part of the Antarctic has been more carefully explored or figured more in scientific memoirs than the McMurdo Sound region of South Victoria Land. We have already elaborate geological papers from the first Scott expedition and from the Shackleton expedition. Even these are eclipsed in voluminous detail by these memoirs of Scott's last expedition. One who has served on a polar expedition knows well the many interruptions that scientific work has to suffer, from weather, travelling, the call to manual work, and so forth. In the face of such difficulties, with which no doubt they had to contend, the amount of scientific research accomplished by Messrs. Griffith Taylor, C. S. Wright, and R. E. Priestley is a monument to their enthusiasm. Dr. Taylor's monograph, written in his customary vigorous style, is devoted to the physiography of the "southern Antarctic" littoral and hinterland, and deals especially with the action of water in the sculpturing of the land. He believes that ice is a less effective agent than ice plus water, and he adheres to the "thaw and freeze" school of glaciologists with leanings at times to the "protective glacier" school. The volume to some extent overlaps the second and larger volume, but that was inevitable and is really an advantage. Messrs. Wright and Priestley have collaborated in the most exhaustive memoir on Antarctic glaciology which has yet appeared, and one that must take its place as a standard work on the subject. Among the fourteen papers in this volume, a few deal with the Antarctic in general and Victoria Land in particular, and some have wider relations.

The classification of land-ice formations has several times been attempted, but not infrequently on too narrow a basis. It is very doubtful if a glaciologist who has no personal experience of Antarctic ice is in a position to tackle this problem, for there is no glacerisation (we use the authors' ugly but useful word) elsewhere to compare with that of Antarctica. The classifications of von Drygalski and O. Nordenskiöld, both of whom have experience of both polar regions, have much in their favour: both are mainly topographical. W. H. Hobbs's classification, on the other hand, though comprehensive, lacks analysis of the major ice formations, and dwells mainly on the minor ice formations of the closing stages of the recession period of a glacial cycle. G. W. Tyrrell lately suggested a new classification based mainly on a study of Spitsbergen glaciers and depending chiefly on the difference in glacier form, motion, wastage, etc., in regions of high relief compared with those of low relief, but this classification is not discussed by Messrs. Wright and Priestley. Their own classification is genetic, and depends on the factors concerned in the degree of glacerisation of a land surface; temperature, precipitation, slope, and denudation or wastage. Thus there are three main types characterised respectively by predominant supply, predominant movement, and predominant wastage. Some forms resulting from a balance between these conditions, and dependent upon their position at sea level, are grouped together as a fourth type. Each type is subdivided partly on the degree of glacerisation, but more especially on the relief of the land. All land-ice formations can be fitted into this classification, and it is certainly admirably suited to a region of advanced but receding glacerisation like Antarctica; but in a region of growing glacerisation—of which, however, the globe does not appear to afford an example at present—it might be less applicable. The outline of the classification is as follows:

I. Ice formations of area of predominant supply.

(*a*) Continental ice masking irregularities of surface (Inland Ice), such as the Antarctic or Greenland ice sheets.

(*b*) Island ice: a similar cap covering a small, isolated land mass.

(*c*) Highland ice which does not completely swamp irregularities of surface: occurs in parts of eastern Spitsbergen.

(*d*) Cwn (or corrie) ice.

(*e*) Snowdrift ice: ice or névé in the lee of projections or in depressions.

II. Ice formations of area of predominant movement, embracing true glaciers moving from the types in I.

(*a*) Wall-sided glaciers unconfined by any marked valley. These are not common and are an exceptional variety of—

(*b*) Valley glaciers, often called alpine or mountain glaciers. These are characteristic of all but the initial and closing stages of the glacial cycle, though "when extreme glacerisation occurs, they will be hidden beneath the upper layers of the Continental Ice and will not thus appear as a recognisable type."

III. Ice formations of area of predominant wastage. These are essentially derived from II, but direct precipitation and snowdrift, and in some cases sea-ice, may augment and compact some varieties.

(*a*) Expanded ice-foot or the lobe of ice beyond the mouth of a valley where a glacier debouches on an unconfined plain. This is more common in such a land as Alaska, where the glacerisation is due rather to excessive precipitation than to snow-line at sea level.

(*b*) Ice tongues afloat: a striking Antarctic ice-form, probably not found elsewhere, unless in Turner Glacier, Alaska.

(*c*) Piedmont glaciers due to the coalescence of several expanded ice-feet. A common type in many polar lands.

(*d*) Confluent ice, formed by coalescence of several ice tongues, and given a definite form by land bar along seaward edge.

(*e*) Avalanche ice fed by avalanches from Type I. All the subdivisions of III have clearly a topographical basis.

IV. Ice formations of zone of balanced forces. These are the most difficult to explain and this is the least satisfactory division in the classification. It includes all forms of shelf ice, of which the most notable example is the famous Ross Ice Barrier.

The authors discuss at length the physics and formation of all these ice forms. As regards the Barrier, they believe that great ice tongues push out into the Ross Sea from the valleys in the surrounding mountain ranges. Sea ice formed in the sheltered waters between them, and, unable to break up or escape, gradually cemented the whole together, while the continual addition of snow smoothed the entire surface. It is now a snow-laden sheet of mixed land and sea ice covering some 150,000 square miles. It is apparently receding, and now probably has a thickness of 750 ft. and an average elevation above sea level of 150 ft. against a possible 800 ft. at the period of maximum glacerisation. Although afloat at its northern end, the whole of it cannot be assumed to be afloat. This and many other equally interesting problems are treated at length in this valuable memoir. Maps and illustrations could not be excelled.

R. N. RUDMOSE BROWN.

## A CENTRAL AFRICAN RACE

*The Bakitara or Banyoro.* By JOHN ROSCOE. The first half of the report of the Mackie Ethnological Expedition to Central Africa. (Cambridge University Press, 25*s*.)

No introduction to an author of such well-proven skill and experience in anthropology as the Rev. John Roscoe is required. His knowledge of the races of Central Africa is unique; he has had the advantage of personal and intimate relationship with the native which his great predecessor, Livingstone, possessed; he has that sympathy and understanding of a primitive people which is impossible to many men, but without which an anthropological study must lose half its value and authority.

The nation which is studied in this work occupies a stretch of pastoral country between Lake Albert and Lake Victoria in Central Africa. The name "Banyoro" is really a nick-name, given to them by derisive neighbours from their habit of occasionally showing favour to a member of the agricultural tribes—who are serfs—by making him a free-man, or Munyoro (plural, Banyoro). Hence their country came to be known as Bunyoro, or the land of freed slaves.

The pre-eminent tribes in the land are those whose life centres round the huge herds of cattle. In every ceremony a bull or a cow takes a prominent place. For instance, when a lover selects the lady of his choice for marriage, he must purchase her for anything up to twenty cows. As the marriage day approaches, the bride anoints her skin with butter to make it smooth. After the marriage party, a fat cow is given to the guests to provide an adequate celebration of the occasion. On one occasion, the fourth day after the marriage, the mother-in-law came in, "bringing her son's milk-pot, and handed it to the bride, who had to wash and fumigate it. The mother-in-law supervised the work as if the bride knew nothing about it, and when the milk-pot was cleansed, she brought a churn and explained its use. The girl was then considered to be a fully trained wife and might leave her seclusion."

Similarly, when a death occurred, an elaborate ceremony involving a bull was necessary. "The heir or the head-man of the clan had to send messengers to inform the king of the death, a ceremony which was called 'Kubika.' Two or three members of the clan, chosen for fleetness of foot, started before dawn and drove a bull towards the royal enclosure. When it had reached the entrance they shouted, 'Afulire mukama ayihongire Nyamionga' [He, —— (naming the man), has left the king and gone to the king of the dead]. This cry was an insult to the king, for it declared that the king of the dead had been too powerful for him, and had succeeded

in robbing him of one of his subjects. When they shouted it the men fled, leaving the bull. The guard of the Bamuroga's men, who kept the royal gate, and guarded the sacred drum in the court, gave chase, and if any of the messengers were caught, they were liable to severe punishment, and might even be killed. The guard, however, did not follow far, for they had to catch the bull, kill it, and cook and eat some of the meat before the sun rose. Whatever was uneaten by the time the sun appeared had to be buried quickly in a pit, which had been dug by some of the guard while the others killed the bull and cooked the meat, for the sun might not be allowed to shine upon it. They dared not try to hide any away and eat it later, for not only would their chief punish them, but the ghost would be revenged upon them if they ate any of it in the sunlight."

The Bakitara are a peaceful and intelligent people. They have many industries; iron-smelting is fully developed and the art of pottery is of a high order. In the art of healing, however, they are little advanced. Most of their efforts to alleviate suffering depend on the art of the medicine-man, who devotes his attention to exorcising ghosts. On the other hand, the art of midwifery shows considerable advance, especially with regard to the preservation of aseptic conditions.

Every part of the life of these people is described with great care, and there are a number of striking photographs. It is not possible in the space available to give an adequate impression of the rich mine of interest and entertainment provided, but perhaps one more quotation may be permitted as an example of an ingenious punishment for an unsuccessful rain-maker.

"Should the rain-makers fail to bring rain when it was wanted, the king had a special punishment for them. Their chiefs had to come to court, where the king ordered to be prepared for them a meal of liver, usually from a sheep or a goat, mixed with blood and fat, and cooked with as much salt as possible. The men had to eat this and sit perspiring in the sun until they were tortured by thirst, but no man dared give them water. Sometimes they were kept like this for several days, fed at intervals with salted meat, but allowed no water; and when they begged for a drink, they were told they must get it as rain or die. Their sufferings often caused them to faint, and they have been known to die without any compassion being shown to them."

This certainly was making the punishment fit the crime. And if it rained too hard, they were sent out in the open with huge pots of rain before them, which they had to drink, until the rain stopped. Apparently, to be a medicine-man in Central Africa is no light or easy task!

R. J. V. P.

## PSYCHO-ANALYSIS AND GROUP PSYCHOLOGY

*Group Psychology and the Analysis of the Ego.* By SIGMUND FREUD. Translated by JAMES STRACHEY. (Allen & Unwin, 7*s.* 6*d.*)

In this monograph Freud applies the latest developments of the psycho-analytical theories to the explanation of the phenomena of group psychology. Setting upon one side the transient type of group, such as the lynch mob or the crowd at a football match, he devotes his attention to the more highly organised herd, or, as he prefers to distinguish it, the herd with a leader, which he considers to be the more primitive type. He brings forward the theory that the individual in the group identifies the other members of the group with his own ego in virtue of their common interest, and he is thus able to extend to them the affection and tolerance that he feels towards himself, and even share his property with them.

The bond with the leader is of another kind: the individual substitutes the leader for his own "ego ideal," and by this term Freud means not only the individual's conception of what he fain would be, but also his "conscience," the aspect of himself that criticises and restrains the activities of the more primitive side of his personality. The leader is also something more definite: he is the image of the father or, in the light of racial memory, of the *patriarch*, and here we have Freud's reason for considering the organised herd to be more primitive than the leaderless crowd.

These two emotional ties Freud uses very ingeniously and logically to explain those characteristics of group behaviour (emotionalism, suggestibility, reduction of critical activity, etc.) that have hitherto been attributed to one irreducible factor, such as suggestion or the herd instinct, and brings these characteristics into line with the phenomena of hypnotism on the basis of the theory, already put forward by the psycho-analytical school, that the relationship between the hypnotist and his subject contains an emotional element comparable to that between parent and child.

In dealing with the more highly organised groups, such as the Church and the Army, Freud brings very interestingly into the foreground the social value of repression—a value that is often obscured in psycho-analytical literature owing to its frequent preoccupation with morbid psychology. Freud holds that the energy and altruism displayed by members of the group, and therefore, one might say, the social virtues generally, derive their emotional force from the well-spring of sexual energy that has been diverted into this channel by the repression of it in its primitive form. There is a hint almost of cynicism in the deduction that the social virtues are enduring because the impulse of which they are the sublimation is never completely gratified.

To account for the repression, Freud brings forward an hypothesis that he first published in his book *Totem and Taboo*, in which he imagines the most primitive society as consisting of a large family group ruled over by a jealous patriarch who restrains the sexual instinct of the younger members, and by so doing converts the unused emotion into a spirit of devotion to himself, so long, that is, as they do not revolt against his authority.

By applying to group psychology the results obtained from the study of the unconscious mind of the individual, Freud illuminates the subject with a new light, and, though many of his readers may question his findings,

yet the book should be of the greatest interest not only to psychologists, but to all who are concerned with the problems of sociology.

F. A. HAMPTON.

*British Plant Names and their Derivations.* By R. J. HARVEY-GIBSON. (A. & C. Black, Ltd.)

A little book giving interpretations of the names of common British plants. It should prove very useful to students, and enable them to fix in their memory names which often seem rather unintelligible. Some of them are very quaint—for instance " bonus-henricus, L. *bonus*, good (as distinguished from Mercurialis, called 'bad'); *heinrich*, from German *heim*, home, as growing in hedges near villages. Others derive the name from 'Heinz and Heinrich,' evil spirits against whom the plant was supposed to afford protection. In any case, the name has nothing to do with any Henry, King of England, good or otherwise." Much careful research and sound scholarship have gone to the making of this book.

*Great and Small Things.* By SIR RAY LANKESTER, K.C.B., F.R.S. (Methuen & Co., Ltd., 7*s.* 6*d.*)

When a distinguished scientist collects his sheaves of scattered papers and articles, written and published in various journals during the last score of years, and presents them in book form, one naturally expects the result to be interesting. And one's expectations are realised in this book, in which, though it contains papers on widely diverse subjects, a sense of unity is preserved since, as the author remarks in his preface, " they all relate to the study of living things ranging from the phagocyte to the gorilla, from the pond-snail to the Russian giant, from facts about longevity to theories as to human progress and the cruelty of Nature." Apart from his writings and individual researches, Sir Ray Lankester has been charged with the responsibility of many important public positions, including the Directorship of the Natural History Department of the British Museum, which he held from 1898 to 1906, and the Presidency of the British Association in 1906. In 1884 he founded the Marine Biological Association. As a man of affairs and as a zoologist his work has been characterised by imagination, enthusiasm, and humanity. These qualities eminently fit him for explaining new scientific discoveries to readers not possessed of the technical languages in which so many of them are veiled as though in the divine clouds of authority.

To many readers, however, the most fascinating articles in this book are those which are more concerned with Sir Ray Lankester's atittude to the general problems and questions of life which are simmering in many heads today, rather than his lucid descriptions of the phenomena of living matter. For instance, he devotes a chapter to answering the question " Is Nature Cruel? " Man is a sensitive, self-conscious animal. With every century of civilisation his self-consciousness appears to be strengthened and his sensitiveness to mental and physical pain to be increased. This fact is reflected in the modern novel over and over again; either the novelist introduces pain into his novel and consciously leaves the reader asking, " What is the meaning of it? " or else he seeks to impose upon his reader the idea of pain, misery, disease, as a mysterious necessity, a part of the scheme of things which must be accepted. Sir Ray Lankester considers that pain does not exist in anything like the extreme pangs which we are apt to attribute to it. " Pain is a mental condition which is not measurable either by the nature and severity of an injury or by the cries and struggles which follow such injury."

The problem of pain has been very carefully studied by the modern schools of psychology, particularly by Freud. These studies show clearly that pain is a protective instrument; it tells the animal, including man, that it is hurt, or is threatened with disease. The author not only agrees with this dictum, but goes farther and says that " man has been, and is still being, educated by pain." He considers that " pain is not, in the great scheme of the universe, 'cruel,' but the beneficent guide of the development of human beings."

In other chapters the author discusses the problem of old age and longevity, his account of Metchnikoff's theory of prolonging life being admirably lucid. On the subject of telepathy he says: " It is necessary to remind those who continue to assert that 'telepathy' is a frequent occurrence and ask us to prove that it is not—or else to admit that it is—that their method is universally condemned. It is for them to bring *conclusive evidence* demonstrating the truth of their contention." In another essay the author shows his sympathy for the idea of human progress and the belief that mankind is not merely driving forward blindly into the dark—a belief which certain men of science have recently been too prone to discourage.

The essays on the " small things," on the Phagocytes or Eater-cells, Pond-snails, the Liver-fluke, Wasps, Spider-sense and Cat-sense, and so forth, are splendid examples of the way in which a scientist with imagination can explain technical subjects in an easy, simple, stimulating way for the benefit of a non-scientific reader, as witness this description of protoplasm: " All living things, whether plants or animals, are either single very minute 'corpuscles' of protoplasm—called 'cells'—or are aggregates, i.e. built-up masses of such cells. Protoplasm is the name given to the very peculiar living, changing 'slime' or viscid material of which every 'cell' is constituted. The name 'cell' was applied two hundred and fifty years ago to the tiny cases, fitted together like the cells of a honeycomb, which the living units, or corpuscles, of protoplasm building up the leaves, stems, flowers, and fruits of plants deposit around themselves. Then the application of the word was actually transferred from the cell or case to its living, slimy content—just as we say 'a bottle of wine,' meaning the liquid contained in the glass bottle and not the glass bottle itself."

E. L.

# Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

*Sidney Ball. Memories and Impressions of "An Ideal Don."* Arranged by OONA HOWARD BALL. (Oxford: Basil Blackwell, 10*s.* 6*d.*)

*Statistical Bibliography in Relation to the Growth of Modern Civilisation.* By E. WYNDHAM HULME, B.A. (Butler & Tanner, Grafton & Co., 6*s.*)

*Ben Jonson's Conversations with William Drummond of Hawthornden.* Edited by R. F. PATTERSON, M.A., D.Litt. (Blackie & Son, Ltd., 7*s.* 6*d.*)

*Studies in Religion, Folk-lore, and Custom in British North Borneo and the Malay Peninsula.* By IVOR H. N. EVANS, M.A. (Cambridge University Press, 20*s.*)

*The Growth of the City State: Lectures on Greek and Roman History, First Series.* By PROFESSOR W. R. HALLIDAY, B.A., B.Litt. (University Press of Liverpool, Ltd., and Hodder & Stoughton, Ltd., 7*s.* 6*d.*)

*The Children of the Sun. A Study in the Early History of Civilisation.* By W. J. PERRY, M.A. (Methuen & Co., Ltd., 18*s.*)

*The Birth of Psyche.* By L. CHARLES-BAUDOUIN. Translated by FRED ROTHWELL. (George Routledge & Sons, Ltd., 5*s.*)

*Our Phantastic Emotions.* By T. KENRICK SLADE, B.Sc. (Kegan Paul, 6*s.* 6*d.*)

SCIENCE

*Special Steels.* By THOS. H. BURNHAM, B.Sc. (Sir Isaac Pitman & Sons, Ltd., 5*s.*)

This book is a double number of one of Pitman's Technical Primers, the excellence and cheapness of which have been mentioned more than once in these columns. All steels other than ordinary carbon steel are described with reference to their constitution, their manufacture, and heat or other treatment. The book should prove a useful compilation both for the student and the practical man.

*The Elementary Principles of Lighting and Photometry.* By J. W. T. WALSH, M.A., M.Sc. (Methuen & Co., Ltd., 10*s.* 6*d.*)

A good account of the whole subject by a member of the staff of the National Physical Laboratory. It is the first connected attempt, we think, to bring the pre-war books on the subject up to date, and gives an informed and interesting account both of present-day theories and current practical work.

*Essentials of Modern Physics.* By CHARLES E. DULL. (G. G. Harrap & Co., Ltd., 5*s.*)

An easily read, accurate, American book, semi-popular in tone and well illustrated; intended to be read more for general information than to defeat examiners, and including detailed accounts of "wireless" and of the mechanism of the automobile.

*Dates and Date Cultivation of the 'Iraq.* Part III. The Varieties of Date Palms of the Shatt Al 'Arab. By V. H. W. DOWSON, B.A. (Heffer & Sons, Ltd., 10*s.*)

*Practical Wireless Sets for All. Home Construction Made Easy.* By P. W. HARRIS. (The Wireless Press, Ltd., 1*s.* 6*d.*)

*The Constitution of Matter.* By MAX BORN. Translated by E. W. BLAIR and T. S. WHEELER. (Methuen & Co., Ltd., 6*s.*)

*Heat and Energy.* By D. R. PYE. (Clarendon Press, Oxford, 5*s.*)

*Practical Bacteriology for Chemical Students.* By DAVID ELLIS. (Longmans, Green & Co., 4*s.* 6*d.*)

*Practical Plant Ecology.* A Guide for Beginners in Field Study of Plant Communities. By G. A. TANSLEY, M.A., F.R.S. (George Allen & Unwin, Ltd., 7*s.* 6*d.*)

*Ductless and Other Glands.* By PROFESSOR FRED. E. WYNNE, B.A., M.B., D.P.H., etc. (George Allen & Unwin, Ltd., 4*s.* 6*d.*)

# Correspondence

## THE BACTERIA OF THE SOIL

*To the Editor of* DISCOVERY

SIR,

Concerning the above article by Mr. P. H. Gray, of Rothamsted, in your interesting publication of June this year, I wish to know if the following line of thought has been investigated.

I believe it is accepted that nitrification and denitrification are products of the ferments of organic matter, the proportion of one species of organism to its opposite in a given sample of humous soil depending upon aeration or oxygen supply and mineral environment. These two species of bacteria are saprophytes in anabolism and catabolism, but am I right in assuming that the denitrifying organisms become septic parasites during fermentation of purely organic substances—hence tetanus, typhoid, tubercle bacillus, etc.? Can you tell me if any experiments have proved productive of results in tracing the origin of such parasites?

Further, as the most important antiseptics, such as alcohol, with its *Bacillus aceticus*, phenol, as mentioned in your paper, and the others, nicotine, etc., presumably have their ferments, sterilisation is therefore, as Pasteur thought, a matter of thermal consideration only.

Thanking you in anticipation of considering an amateur's enquiry.

Yours, etc.,

C. G. BISHOP.

30 FAIRMILE AVENUE,
STREATHAM, S.W.16.
*June* 25, 1923.

[The points raised by Mr. Bishop are of some importance, since there is frequently misunderstanding on the question of bacteria in general and those which cause disease. Of the many thousands of species which have been described, only a few dozen familiar forms of bacteria can withstand the rigorous conditions inside the animal organism and

so cause disease. Some of these—for example, the bacillus of tetanus—usually inhabit the soil, as our correspondent states—that is to say, heavily manured soil. It does not, however, "become" malignant at any period—it is always capable of causing tetanus, if it gains access to the human body through a cut. The other bacteria of the soil are, for the most part, as different from the bacteria of disease as a domestic cat from a tiger.

The second question—whether heat alone can be relied upon to sterilise—can be answered by considering the fact that the bacterium is a living creature, or rather a living plant. It is possible to sterilise anything with absolute certainty by immersing it in quite weak solutions of hydrochloric acid. One great feature of all living matter is its sensitivity to acids; when our blood becomes the very tiniest degree more acid, we suffer severe discomfort. Heat, since living matter is capable of being coagulated, like the white of an egg, will kill bacteria; and since surgical instruments, etc., cannot be placed in acids, heat is the method most used for sterilisation.

There are, as Mr. P. H. Gray has shown in DISCOVERY, queer outrageous bacteria which can devour weak solutions of carbolic acid. But concentrated carbolic acid would kill them. The *Bacillus aceticus*, which turns alcohol to vinegar, could not affect what is known as "absolute" alcohol. These bacteria are comparable with those sea-side plants which can grow in the salt spray where daisies and lilies would die; but even they could not stand the salt wastes of the Dead Sea. There is a limit to animal adaptability; some bacteria—the cacti and camels of their kind—can resist most rigorous conditions, but even they can be slain, by heat or by sufficiently drastic chemical treatment.—ED.]

## SUSPENDED ANIMATION

*To the Editor of* DISCOVERY

SIR,

Sir Arthur Shipley, in his contribution to your July number, dismisses "the repeated accounts of toads having been found embedded in rock as fables."

In 1905 I helped to excavate a cellar in Kansas, U.S.A., the summer being well advanced, the weather hot. The two feet of loamy soil were imposed upon a bed of an argillaceous formation several feet thick, in the vernacular designated "hard pan," so dense that a man working hard with pickaxe and shovel could make small headway in a day. Four feet from the surface I struck my pick into a corner and heard a peculiar little pop; on withdrawing the pick I found I had driven it through the body of a toad. The animal kicked convulsively for a few seconds before succumbing. There was the exact print of the toad in the "hard-pan," but no means of exit from its imprisonment that I could discover. The toad was small, and of a pale, sickly cast; there was little pigment in the skin.

Can any person believe that the animal was in that position voluntarily at that season of the year? If so, he can believe anything. The site of the cellar was near an inhabited house; the ground had been well tramped upon for years.

This locality where I now live is underlaid with calcareous, sedimentary rock, the quarrying of which is the principal industry. A short time ago I was informed by an intelligent man, a native, that some years ago a toad was found embedded in the rock, alive, and living witnesses are still here who were present when the animal was discovered.

Yours, etc.,

KEINTON-MANDEVILLE, SOMERSET. ALBERT W. HOOTON.

*June 27, 1923.*

# News of the Month

## THE SEPTEMBER BRITISH ASSOCIATION'S MEETING

THE annual meeting of the British Association for the Advancement of Science takes place this year at Liverpool, from Wednesday, September 12, to Wednesday, September 19. It will be the Association's ninety-first meeting, and the fifth time that the gathering has been held at the famous port. When the Association went to Liverpool in 1870, it was presided over by Huxley; Tyndall and Rankine delivered the two evening discourses, and Lubbock the "lecture to the operative classes."

With every year the realisation of the need for the practical application of science to life and industry is increasing. The forthcoming meeting is apparently designed to meet this realisation, and its effects may, we hope, be considerable. Its *rendezvous* is appropriate, for, as the Preliminary Programme remarks: "Visiting members of the Association will find a city where the application of science to industry and trade is on every hand."

This year's president is Sir Ernest Rutherford, whose address will deal with the latest researches into *The Electrical Structure of Matter*. The character and trend of the meeting which we have intimated is borne out by many of the sectional addresses. Prof. J. H. Ashworth will consider *Modern Zoology: Its Boundaries and Some of its Bearings on Human Welfare*; Dr. Vaughan Cornish, *The Position and Opportunity of the British Empire*; Dr. C. Crowther, *Science and the Agricultural Crisis*; Sir H. Fowler will discuss *Transport and its Indebtedness to Science*; Prof. T. P. Nunn, *The Education of Demos*; Mr. C. Burt, *The Mental Differences between Individuals*; and Sir W. H. Beveridge will show the relations of *Unemployment and Population*.

Some of the sectional discussions, too, should be of much practical value—those, for instance, on *Psychological Assumptions Underlying Economic Theory, The Methods of Anthropology in Relation to the Social Sciences, The Outlook for British Agriculture*, and *The Delinquent Child*.

Two interesting features of the meeting are that public lectures are to be delivered by various members of the Association to the public and to children in Liverpool and various neighbouring towns, and that Sir William Rutherford's address will be broadcasted by wireless.

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